the OIL AND GAS JOURNAL

MARCH 31, 1958

WHAT 8 PRODUCING DAYS WILL MEAN TO TEXAS—

"Most significant domestic development since Spindletop" . . p. 47

Here's What the New Imports Plan Looks Like

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Introducing:

ALKAR AND BUTAMER

Two processes for improving refinery products . . . . . p. 73

More Hole for Your Money!

Here's a simple method of determining combination of weight on bit, rotary speed, and hydraulic horsepower for lowest drilling cost . . . . . p. 90

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THE FIRST HUNDRED YEARS

In just a few months, the petroleum industry will note the beginning of its hundredth year from the date of the Drake discovery. From this modest start, the oil business has grown into an empire of energy . . . one of the vital sources of power for the needs of man.

Reviewing the past and previewing the future . . . one of the most important factors contributing to oil's commanding position is research – the continuous investigation to do things better. Halliburton will continue to devote a substantial share of its resources for "the better way."

HALLIBURTON OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
March 31, 1958

Oil men have their eyes on two uneasy trouble spots abroad:

Saudi Arabia's "palace revolution" has armchair experts gloomy over the future of Middle East oil investments.

Sumatra's shooting revolution has caught American oil interests right in the middle.

Oil companies with a real stake in Middle East stability aren't sure what's going on in Saudi Arabia. They doubt anyone outside Riyadh Palace circles knows.

For the record here's what has happened: King Saud, an absolute and pro-West monarch, has given his brother Faisal full power over the country's internal, external, and financial policies. Some say this is a victory for Nasser and his Arab Republic. Others point out that Faisal always has been both premier and foreign minister anyway.

Even if there has been a palace revolution, oil men say it's unlikely that the Saudi princes are going to do anything to upset a system which brings them so much riches.

Both Caltex and Standard Vacuum are back operating oil fields in Central Sumatra right in the midst of revolution.

Their 2-week shutdown cost the Central Indonesian Government $150,000 daily in revenue. Central forces took control of the Siak River waterway to allow oil operations to resume.

How long this will last is still a question. Rebels now have warned ominously they cannot afford to let the companies work in the interests of the Jakarta Government.

Full extent of planned imports cut now is known.

As predicted, the new program will follow this pattern:

...Voluntary approach will be followed.

...Cut in volume of crude will be about 8 per cent.

...Old line importers will be asked to move over to make room for quotas to newcomers.

...Review of the program will be made again in June, and if the voluntary approach is not working then mandatory quotas will be set up.

Italian oil circles predict a move soon toward nationalizing Italy's refining industry.

They say that will come if the leftist Christian Demo-

crats win a majority in parliament in the May 25 elections. Man behind the move will be Enrico Mattei, volatile head of Ente Nazionale Idrocarburi, state-owned oil agency.

Algeria is slated for a new oil law calling for the traditional 50-50 profit split.

The French Government now has the new legislation ready. It will be similar to French oil laws, which do not provide for royalty payments but which subject oil companies to corporation taxes and other levies.

Latest Algerian oil strike will far overshadow the two smaller fields previously found in the Sahara.

The ZR-2 well of Creps tested 3,200 bbl. daily of 43°-gravity crude from a section 164-ft. thick. It was drilled on the flank of a structure that may cover 40 sq. miles. It is about 30 miles northwest of Edjele field.

Two important wildcats in Alberta's far north country have oil and gas shows in the Middle Devonian.

If successful, they would jump production 200 miles north of Red Earth Creek and Peace River areas.

Canadian Seaboard's Hay River well made 500 M.c.f. of gas on test at 4,250 ft. and had 450 ft. of oil, gassy and mud-cut. Decalta's well recovered about 500 ft. of gassy oil-cut mud on test at 3,750 ft.

Exciting developments may be in store for Paradox basin.

Cluster of wildcats now on the basin's edge may leapfrog production north and west to the Colorado River within 2 years.

Development drilling also is showing up great (p. 137).

Of 73 field wells completed in the basin so far this year only 8 have failed. Don't be surprised if the probably productive area of the basin is doubled by year's end.

A monster field—somewhere near half billion barrels—may also be developing within the basin. It will come if present stepout drilling should merge Aneth, White Mesa, McElmo Creek, and Ratherford fields into one productive area.

Geologists think it's a good bet the Denver basin may be extended into Northwest Kansas.

Cretaceous possibilities look good (p. 138). The rocks in Northwest Kansas are as much as 3,000 ft. thick, contain good reservoir beds, have favorable structure and stratigraphic variations for traps, and are reported to have had numerous shows.

The Mississippian drilling campaign in North Dakota's Burke County continues to dominate other Williston basin exploratory events.

New strikes are indicated 1½ miles northeast of Flaxton field and 9 miles south of Lignite production. The southwestern part of the county also figures in the play with new success reported north of Tioga field.

Rigs running in the state now total 34. That's nine more than for the same time last year.

An attractive tax climate for oil development is being created in Arizona. Hope of the Arizonans is to increase present tempo of oil exploration.

Arizona Senate recently passed a resolution praising the economic value of the oil industry to the state and advising the state not to impose prohibitive taxes.

The senate resolution followed death in committee of a house-approved bill levying a 2 per cent production tax on oil and gas.

Underground offshore storage of tidelands oil may be a development of the future, the U. S. Geological Survey reports.

Here's how it could work: Cavities dissolved in shallow salt domes could be used. This would allow ocean-going tankers to load at the site.

Advantages would be lower handling and transportation costs, speedier movement to market.

Other predictions on offshore work: Drilling from ships without platforms and remote control of both production and pipelining from shore.

OCAW union estimates layoffs have hit 5 per cent of its members since January 1.

Labor leaders admit this is below average for all industries, but they draw one gloomy conclusion: Many of the layoffs in OCAW jurisdiction have the appearance of being permanent.

Refiners got a jolting pep talk last week.

Keynoting the 46th annual meeting of WPRA in San Antonio, Harry J. Kennedy of Conoco bluntly said: "Let's admit that things aren't as bad right now as they seem." His advice: Quit muttering the blues.

Refiners have had some good times in the last few years and they will again, Kennedy said.

Watch the road-building program. Asphalt may be shoved out of the picture.

That's the warning of J. E.Buchanan, president of the Asphalt Institute, talking to refiners last week. He said:

Under the federal program, states pay 10 per cent of costs but design the roads and decide on type of paving. They are likely to disregard economy, which would dictate low-cost asphalt.

It's the job of the entire industry to combat such a trend. Use of asphalt in pavement helps sell the whole barrel of crude.

Guessing game on petroleum demand for 1958 brought out some interesting predictions recently at Austin (p. 54).

Some oil economists said demand will show no gains over 1957. Most optimistic was a guess of 3.6 per cent gain. Average of all predictions was a gain of 1.14 per cent this year.

The economists also gave the industry an excellent picture of its excess stock position. They reported the ideal total of all crude and products stocks on April 1 should be 569.3 million barrels. Stocks actually are 651.3 million barrels. That means stocks are high by 82 million barrels or 14.4 per cent.

The ideal stock picture for this year compared with last year and with actual shows:

	Ideal level April 1, 1957	Ideal level April 1, 1958 (1,000 bbl.)	Actual stocks March 21, 1958
Crude	260,800	260,330	*283,846
Gasoline	187,800	187,330	216,907
Kerosine	18,500	17,850	17,178
Distillate	65,500	66,120	78,449
Residual	38,500	37,670	55,013

*For March 15.

Oil management generally is looking past the present slump to the long-term potential.

Two instances came to light last week:

Indiana Standard is budgeting 31.5 per cent more for exploration and production in 1958 than last year, and 47.9 per cent more in capital outlays for domestic manufacturing, marketing, and transportation. The outlay totals $470 million.

Texaco estimates its capital and exploratory outlay for 1958 will reach $500 million, up from $481.7 million last year.

More oil-company earnings reports are out: American Petrofina up to $1.5 million from $569,725; British-American up to $32.1 million from $25.1 million; Champlin up to $9.7 million from $9.4 million; Clark Oil & Refining down to $1.4 from $2.4 million; Gulf up to $354.2 million from $282.6 million; Shell down to $135.08 million from $135.8 million; Sunray Mid-Continent up to $57.1 million from $45.3 million; Texas Company up to $332.3 million from $302.2 million; Tidewater down to $34.9 million from $38.7 million; Zapata Petroleum down to $155,183 from $411,415; Arkansas Fuel Oil up to $8.6 million from $7.5 million.

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TECHNOLOGY–OPERATION

Refining-Processing

Alkar and Butamer—Two New Refining Processes . . . 73

By A. W. Grote

The Butamer process promises to fill the need for efficient and economical conversion of normal butane to isobutane with a minimum capital investment. The Alkar process, on a scale heretofore impractical, utilizes by alkylation the light olefin content of the refiner's fuel gas.

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Here are suggestions by men who are experts in their field on how to solve problems in cat cracking, cat reforming, alkylation, and other refining processes.

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Stimulation Techniques Boost Gas Production . . . 77

By A. B. Waters, F. N. Liscum, and H. J. Ayres

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A Method for Determining Optimum Drilling Techniques . . . 90

By John W. Speer

A simple method has been developed for determining the combination of weight on bit, rotary speed, and hydraulic horsepower which produces minimum drilling costs. Empirical relationships are developed to show the influence on penetration rate of weight on bit, rotary speed, and hydraulic horsepower. Optimum weight on bit is shown in relation to formation drillability and optimum rotary speed is related to weight on bit. These five relationships are then combined into a chart for determining optimum drilling techniques from a minimum of field test data.

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By Dr. John M. Campbell

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Pipeline Analyzer Speeds Flow Computations . . . 82

By Paul C. Constant

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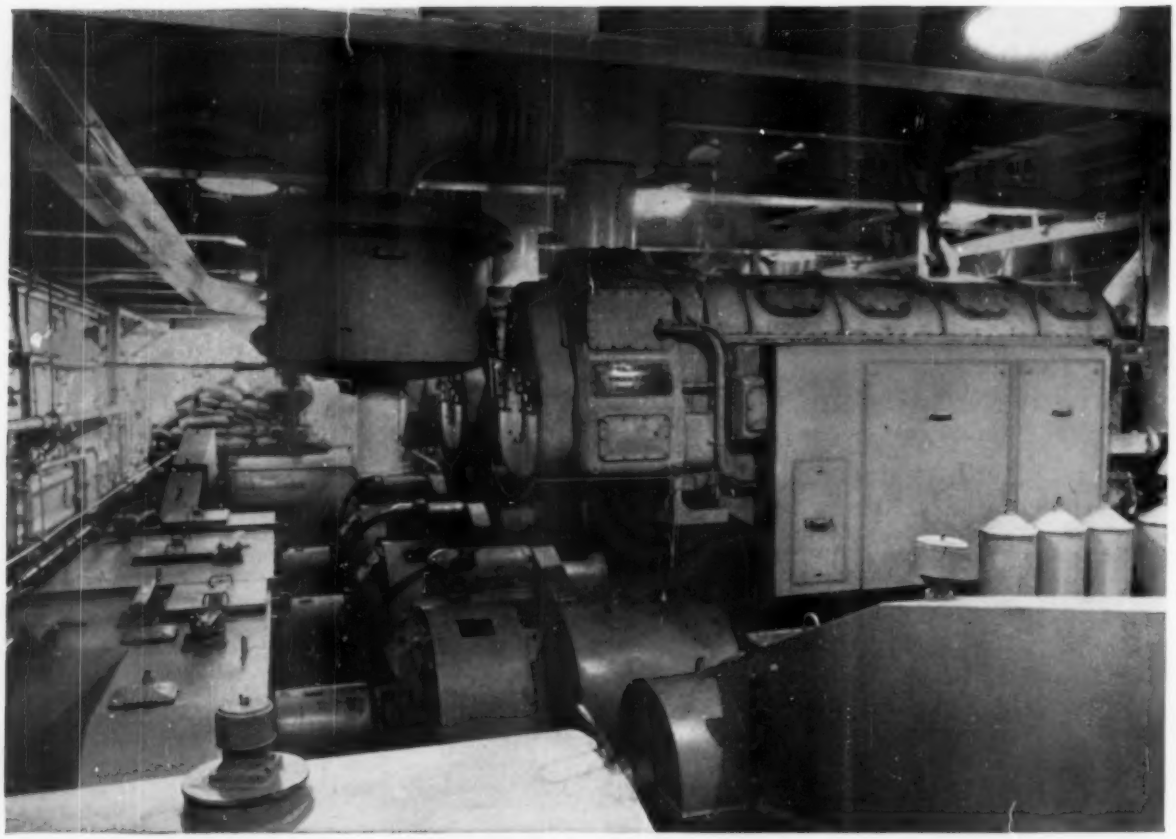

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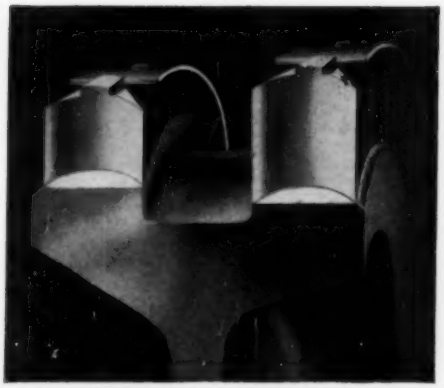

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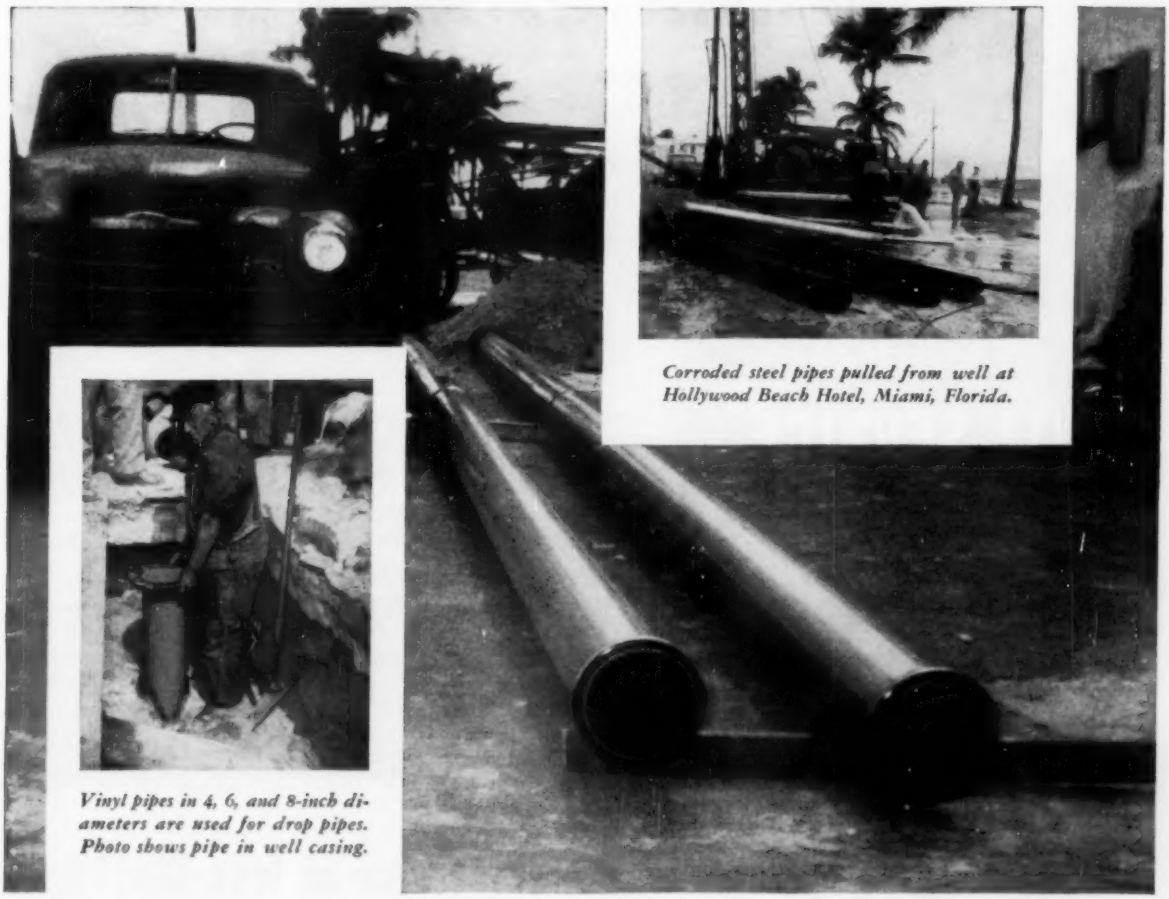

Corroded steel pipes pulled from well at Hollywood Beach Hotel, Miami, Florida.

Vinyl pipes in 4, 6, and 8-inch diameters are used for drop pipes. Photo shows pipe in well casing.

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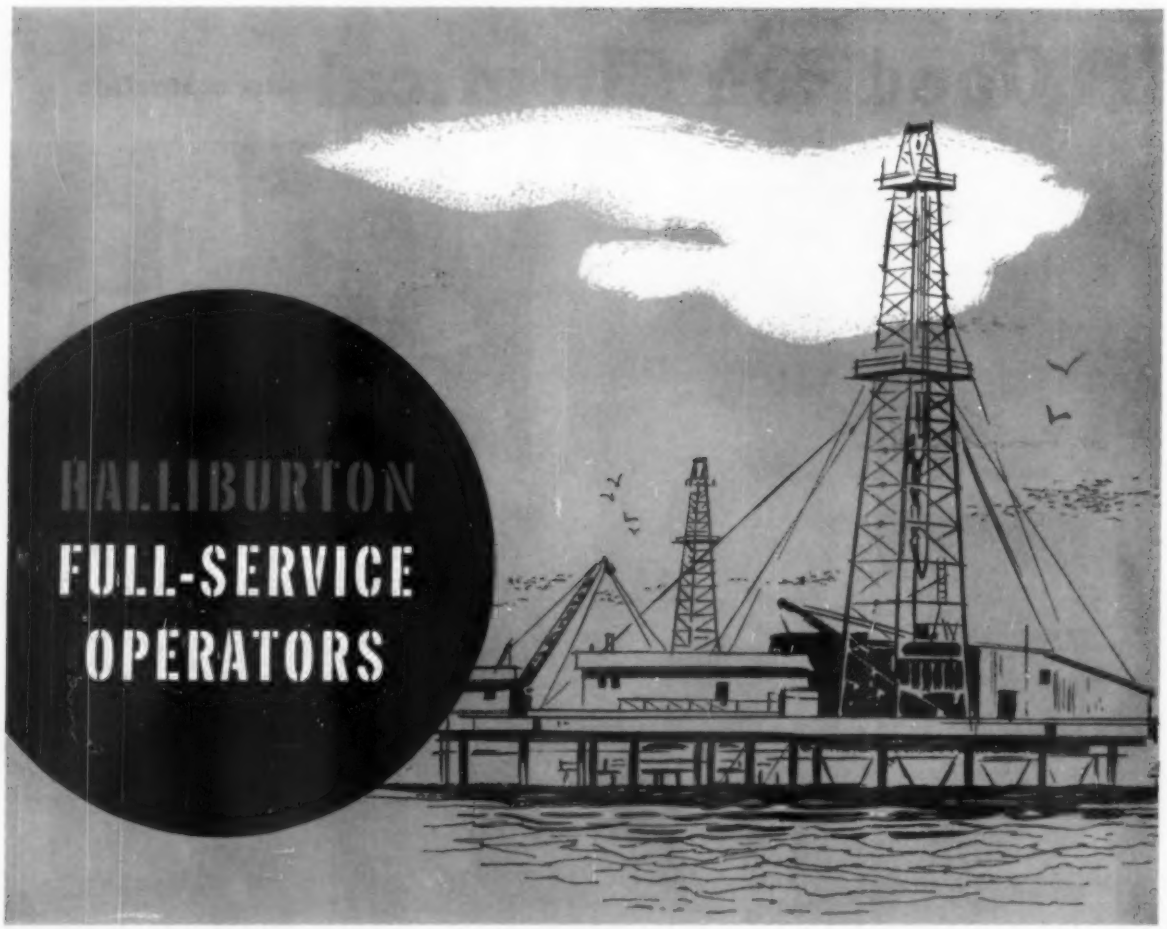

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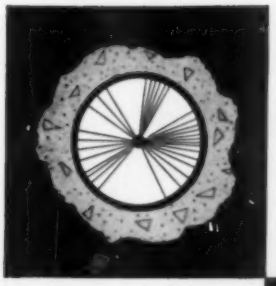

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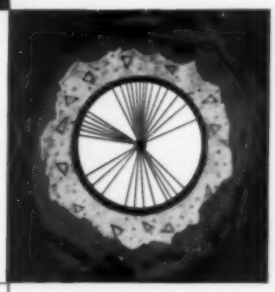

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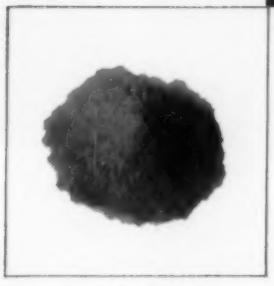

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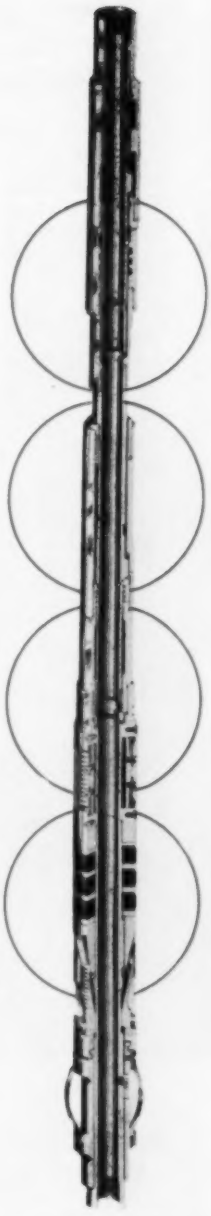

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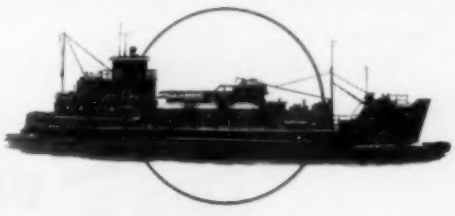
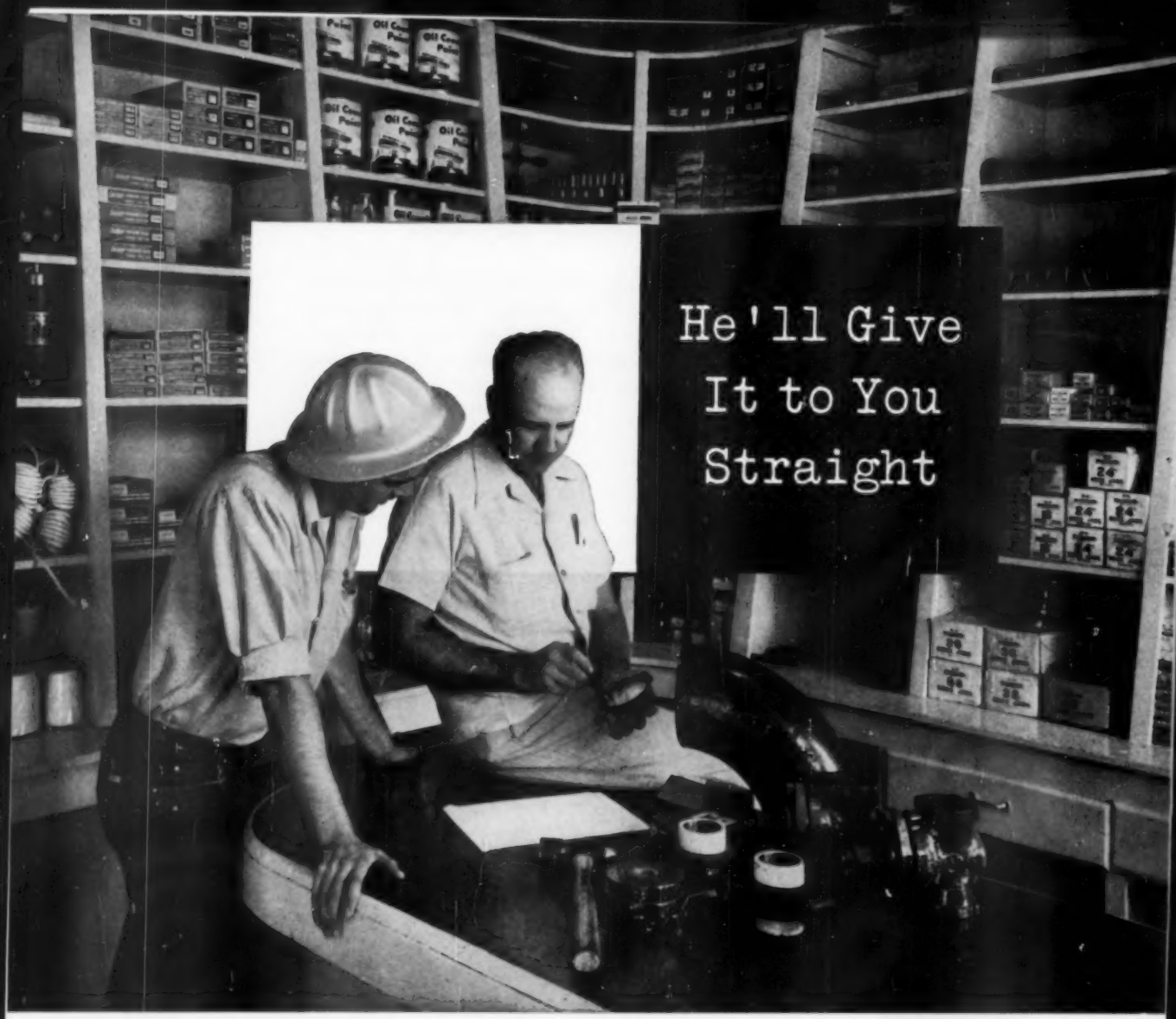
Here's one dependable combination tool that Halliburton offshore specialists rely on for one or more jobs on a single trip... acidizing, fracturing, testing or squeeze cementing. Simple tubing manipulation operates the RTTS Packer which has full opening mandrel for treatment with large fluid volumes or passage of tubing type perforating gun. Safety joint with drillability features for squeeze cementing. Circulating valve to equalize tubing and annulus pressures at Packer when desired.



OFFSHORE SERVICES

All-Ways The Leader In Advanced Offshore Services



Straight talk is something you can count on in any Bethlehem Supply store. Whether you're buying a gage in Casper, Wyoming, or looking over a pumping unit in Pampa, Texas, Bethlehem storemen will give you complete information, with facts unadorned.

You're entitled to know what you're buying, and what it will do. The Bethlehem Supply man can help. He knows every item of his stock, and he knows, moreover, that his store carries nothing but first-class merchandise. Hence he can always be specific, and can make his recommendations with confidence. And you, the customer, can accept them with confidence.

That's just one of the many good reasons for doing business with Bethlehem Supply. Another is the fact that every Bethlehem store is fully stocked to meet the demands of the area served. You can be mighty sure that the store you deal with carries the items needed locally.

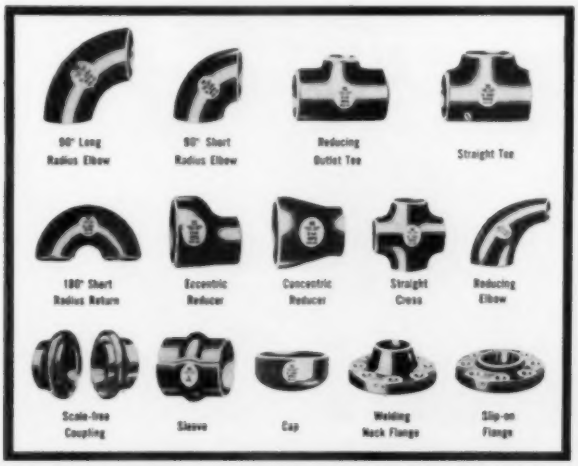
Bethlehem Supply covers a big territory — from eastern Illinois to the Pacific, and from the Gulf Coast to North Dakota. There are 63 domestic stores. And farther north, Bethlehem Supply Company of Canada, Ltd., has a fine store in Edmonton. Open an account with the one nearest you.

BETHLEHEM SUPPLY COMPANY
General Offices: 21 E. Second St., Tulsa, Okla.
West Coast Headquarters: Los Angeles, Calif.
Canadian Distributor: Bethlehem Supply Company of Canada, Ltd.
Calgary, Alberta, Canada
Export Distributor: Bethlehem Steel Export Corporation
25 Broadway, New York, N. Y.

BETHLEHEM SUPPLY

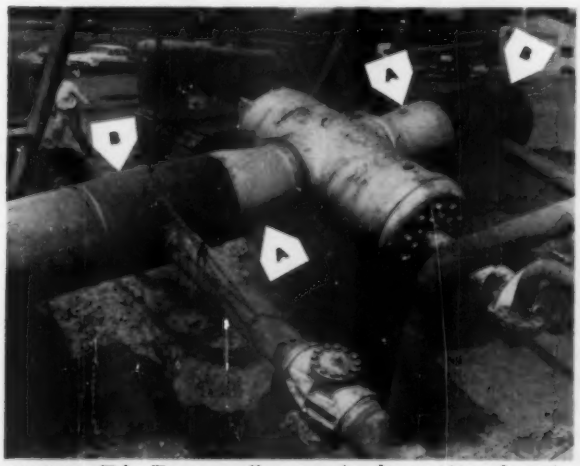
You get FAST DELIVERY

from the world's most complete line of pipeline fittings



12,000 ITEMS. All types of welding fittings and flanges . . . sizes . . . schedules . . . yield strengths . . . materials to match your needs. Pipeline fittings 16" through 42" described in Catalog TT 638.

LARGE OR SMALL. Carbon steel fittings and flanges as large as this 42" elbow . . . or as small as ½". Lightweight fittings for gas distribution lines are available in sizes of 4" through 24".



SPECIALS. Tube Turns supplies venturi reducers (A) and manifold fittings (B) for valve installations such as shown. Also anchor forgings, full encirclement saddles, odd angle elbows and other pipeline special fittings.

YOUR NEARBY DISTRIBUTOR provides this complete line service. You can order standard and special TUBE-TURN® products from him . . . all on one order . . . and cut purchasing red tape.

"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit Atlanta • New Orleans • Houston • Midland • Dallas • Tulsa • Kansas City Denver • Los Angeles • San Francisco • Seattle

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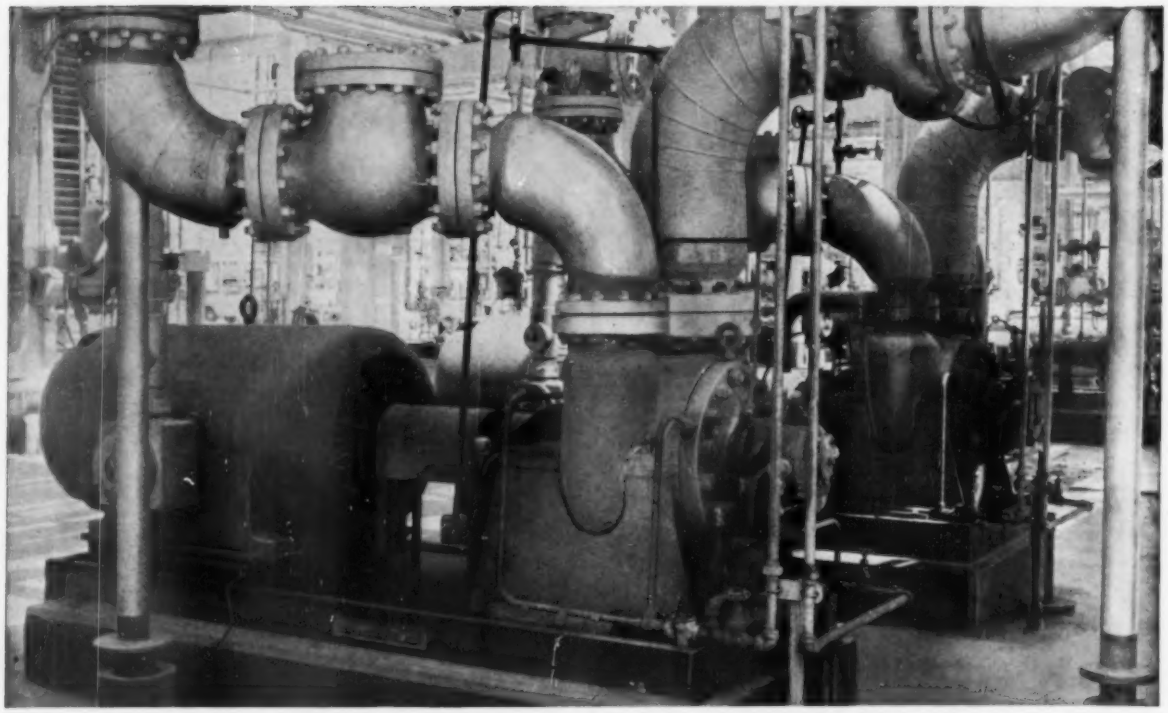
tt TUBE-TURN



Two Ingersoll-Rand 300-hp Class CJVL solvent-circulating pumps in new reforming unit at Cosden Refinery, handling glycol at 1100 gpm.

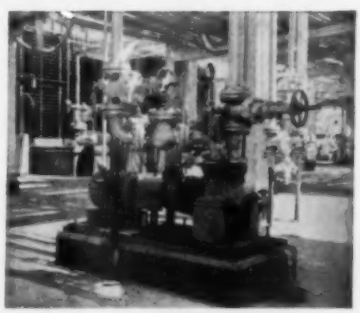
CIRCULATING and TRANSFER PUMPS

at Cosden Rexformer Unit

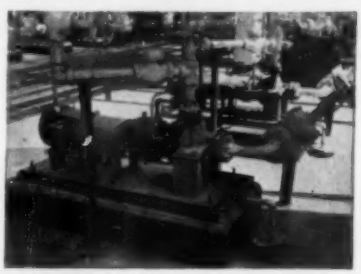
Ingersoll-Rand Centrifugals keep new Reformer On Stream, deep in the heart of Texas

AT THE Big Spring Refinery of Cosden Petroleum Corp., these Ingersoll-Rand circulating and transfer pumps are vital components of the new U.O.P. designed Rexforming Unit for high-octane gasoline production. A total of *thirty* I-R pumps serve this reformer plant alone — in reflux and charge service as well as circulation and transfer. Each pump is the "heart" of its own fluid circuit — and each is vital to the trouble-free performance of the entire plant. That's why the traditional *dependability* of I-R pumps is a very real advantage. Their high efficiency and low maintenance help cut operating and upkeep costs, too.

Whatever your refinery or process pump requirements, there's an I-R unit that's right for the job — right in size, capacity and type of drive. For a quick solution to your pumping problems, just call your nearest I-R Branch Office.



Ingersoll-Rand Class MFL pump transfers 90 gpm of high octane gasoline from Udex unit to storage.



Two Ingersoll-Rand Class BSFL pumps transfer bottoms on No. 2 tower to storage for Rexformer. Pump delivers 45 gpm.

Ingersoll-Rand

10-690 11 Broadway, New York 4, N. Y.

PUMPS • COMPRESSORS • DIESEL ENGINES • AIR & ELECTRIC TOOLS • TURBO BLOWERS • CONDENSERS

keep 'em turning to the right . . .

Type "C" Drill Collar Slips

Use Safe, Sure-grip BAASH-ROSS Slips

Running tubular goods with Baash-Ross Slips helps keep your operation safely "turning to the right." Each type, specially designed to hold a particular kind of pipe, grips tightly and evenly with no danger to pipe, crew or other equipment.

Type "DU" Rotary Slips in regular and long types can be adapted to run pipe on any depth well. Replaceable, segmented liners with small truncated pyramid wickers transfer all stresses of supporting pipe directly to slip body. Three basic body sizes will hold any pipe from 2⅜" O.D. through 7" O.D. through the use of interchangeable liner sizes.

Light, safe, and easy to handle Type "C" Drill Collar Slips have long, narrow, multiple segments individually hinged to freely conform to the drill collar and bushing surface. Drill Collar slips are made for all sizes of drill collars—from 3" diameter, to and including 10" diameter, in 5 basic body sizes. Body extensions provide a Safety Clamp seat and the carefully heat-treated alloy steel liners are easily replaceable.

Type "DU" Rotary Slips

For full information see Composite Catalog or write Dept. B 3-31, P. O. Box 1348, Houston 1, Texas

BAASH-ROSS DIVISION
OF JOY MANUFACTURING COMPANY

BAASH-ROSS JOY

GENERAL OFFICES: 5306 CLINTON DR., HOUSTON, TEXAS

AREA OFFICES:

Houston, Texas; Odessa, Texas; Dallas, Texas; Long Beach, Calif.; Denver, Colo.; Oklahoma City, Okla.; Olney, Ill.; Mexico City, Mexico; Edmonton, Alberta, Canada.

FOREIGN OFFICES:

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Formula to sweeten a gaseous giant!

...feed it to a gas-scrubbing unit and let the laws of equilibrium take their course. Tremendous volumes of natural or refinery gas can be freed of hydrogen sulfide or carbon dioxide as Jefferson Ethanolamine does its work over and over again.

For *any* application, Jefferson Ethanolamines are available in the purity and volume you need—backed by excellent service from modern production facilities. **Jefferson Chemical Company, Inc., 1121 Walker Avenue, Houston 2, Texas.**

Mono-, Di- and Triethanolamine are available in tank cars of four to ten thousand gallon capacity, in tank wagons, and in 55-gallon drums.

Jefferson CHEMICAL COMPANY, INC.

Essential Chemicals from Hydrocarbon Sources

Ethylene Oxide,
Glycols, Dichloride
Ethanolamines
Morpholine
Piperazine
Polyethylene Glycols
Nonyl Phenol
Surfonic®
Surface-Active Agents
Ethylene Carbonate
and Propylene Carbonate
Caustic Potash
Caustic Soda
Soda Ash
Sodium Bicarbonate

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Vertol 44 solves transport problem for oil industry

The petroleum industry has a new tool, the Vertol 44 helicopter, to cut manhours, money and misery out of exploratory drilling at remote sites.

The Vertol 44 is a heavy-duty, universal vehicle that makes the sky a 100 mph highway, almost any clearing a landing field. Gone is the need to hack roads in jungle, swamp and mountains. You may need it for these money-saving missions:

Flying Truck: The Vertol 44 carries more than 2 tons of cargo in tropical areas...transports the entire 175,000 lbs. of a drill rig over a distance of 50 miles out and back, in only 56 flying hours. Its 600 cu. ft. cabin accommodates 50% more cargo than any other commercial helicopter, with no problem of load placement.

Flying Bus: Airlifts up to 19 passengers ... 2 typical field crews ... to jungle derricks or offshore drills ... flies exploration teams to otherwise inaccessible spots.

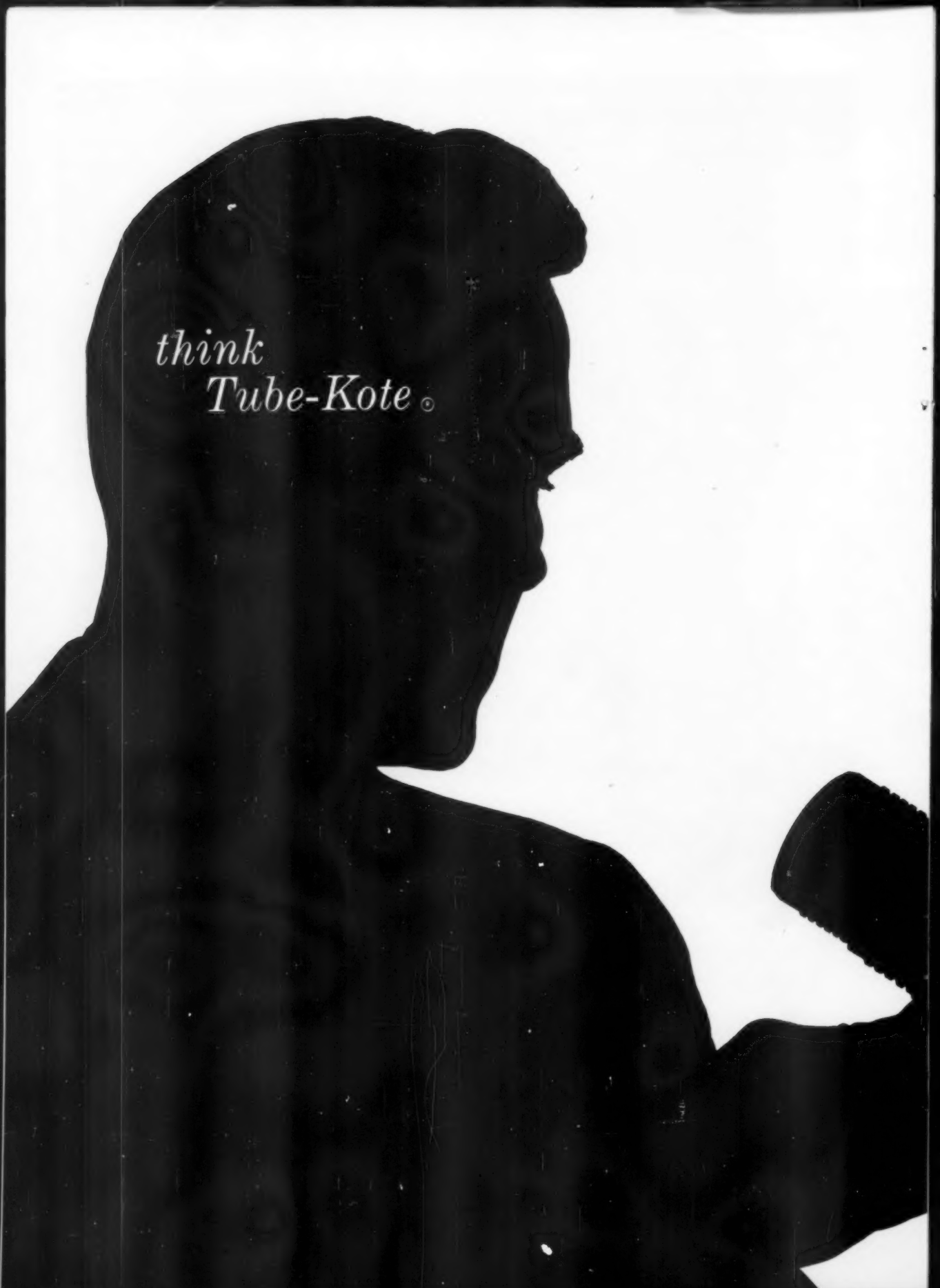
Flying Crane: Hops rivers, ridges and swampland with sling-loads of pipe, rig superstructure, large pump components or even mobile field offices.

Flying Tractor: Frees mired vehicles, hauls barges, drags sledges. It has even towed a 3,000-ton ship.

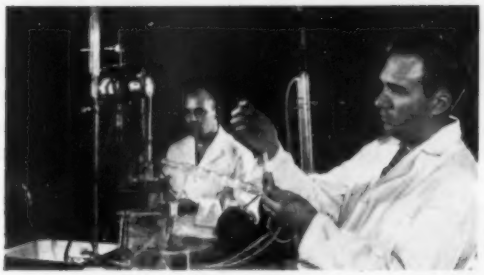
For more information on this multi-purpose vehicle for the oil industry, write to: Customer Relations Department

VERTOL Aircraft Corporation

MORTON, PENNSYLVANIA.


think
Tube-Kote ⊙

Tube-Kote coatings also are used to prevent paraffin accumulation and to protect tanks and vessels from all types of corrosive deterioration.



Tube-Kote research is available to you in solving your specific corrosion problems . . . to increase your company profits by decreasing operating costs.

SUPERIOR COATINGS TO STOP CORROSION

The acceptance of plastic coatings to protect oil field tubular goods from corrosion is widespread in the oil industry. Likewise, Tube-Kote is accepted as the pioneer of every major improvement in plastic coatings since 1939. Through research, Tube-Kote has developed many coatings . . . each with special properties needed to solve unique corrosion problems . . . each developed to rigid specifications before marketing. Think Tube-Kote when you need pipe coatings.

TUBE-KOTE®

TUBE-KOTE

P. O. BOX 20037 • HOUSTON 25, TEXAS BRANCH PLANT • HARVEY, LOUISIANA

EXPORT REPRESENTATIVES: LUCEY EXPORT CORP. 223 BROADWAY NEW YORK 7, N.Y.

Tube-Kote research and superior methods bring you more durable coatings and faster service . . . at lower cost!

Here's a NEW WELDING TORCH that's WATERTIGHT... built for HEAVY-DUTY SERVICE ...yet weighs only 7 OUNCES!

This new HELIARC HW-18 Hand Welding Torch weighs only 7 ounces, making it easy for you to handle, less tiring. The special one-piece water cooling channel eliminates sources of leakage. And it's made for rugged, heavy-duty service.

YOU GET BETTER SHIELDING WITH LESS GAS

Improved design of collet body and closer electrode fit assure uniform argon flow, without jetting or turbulence.

◀ Diagram shows leakproof, one-piece water cooling passage in LINDE's new HELIARC HW-18 Hand Welding Torch.

GIVES YOU RUGGED SERVICE

Torch body is Fiberglas-reinforced phenolic for greater resistance to heat and thermal shock. Handle is tough, polished plastic. Gas cups have 4 times the impact strength of ordinary cups.

LEAKPROOF

Molded, one-piece water cooling passage has no joints to permit leakage—no water drip to contaminate welds.

EASY, MORE ECONOMICAL MAINTENANCE

Collets, collet bodies, cups and caps are interchangeable with those of your HW-17 Series 2 Torch. All couplings have standard IAA connections, and adaptors are included. Your production costs are lowered, too, for the new HW-18 saves time in hard-to-reach spots. Torch is designed for continuous 300-amp service, a-c or d-c.

ARGON SHUT-OFF VALVE

(Optional) saves time, steps and argon.

See and try this new HELIARC HW-18 Torch! For a demonstration, mail coupon today. Or call your distributor or nearest LINDE office. LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. In Canada: Linde Company, Division of Union Carbide Canada Limited.

Dept. O-35, LINDE COMPANY, Division of UCC
30 East 42nd Street, New York 17, N. Y.

Please advise me where and when I can examine and try out the new HELIARC HW-18 Hand Welding Torch.

NAME_____

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____

FOR THE BEST IN ELECTRIC WELDING LOOK TO *Linde* TRADE-MARK

UNION CARBIDE

The terms "Linde," "Heliarc," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

LOST

ONE

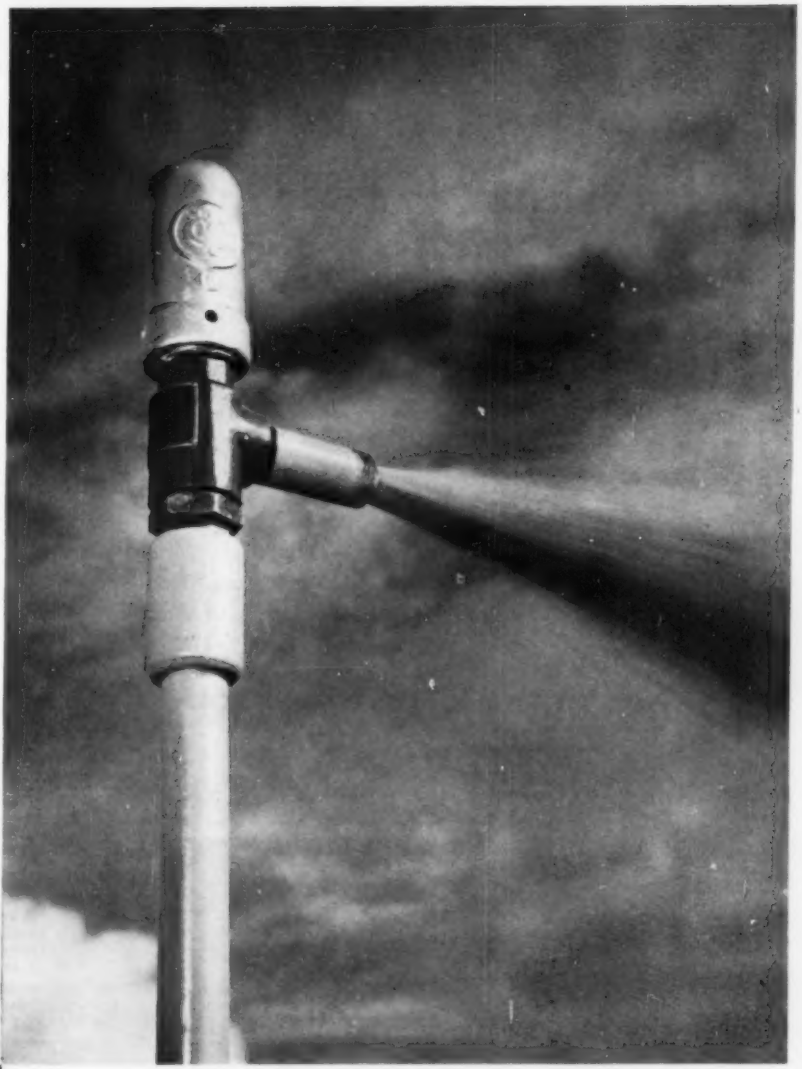
COMMON NAIL

SAVED

$2,376.46

Destructive pressure overloads are no problem when Cameron Shear-Relief Valves are on the job.

A common nail (U. S. Standard) takes the punishment instead of expensive pumps, manifolds and other mud line equipment. Fluid contacts the valve's piston, and when desired pressure is exceeded, the piston stem shears the nail. It's as simple as that, and what's more, you don't have to know if the nail is 60 penny or 16. A handy nail gauge is part of the name plate. Any rig hand can make a correct setting in seconds. The piston stem is stainless steel hardened for extra strength and wear resistance. The bonnet and sub are also stainless steel to prevent corrosion. The synthetic rubber piston is leak-proof and will not stick. When this valve opens, it opens all the way. A cushion ring stops the piston to prevent damage, and a safety cap holds the clipped nail until another is inserted. These are reasons why you will find money-saving Shear-Relief Valves on drilling rigs throughout the free world.



Cameron makes a complete range of Shear-Relief Valves with settings for pressure relief from 125 to 10,000 psi in two inch and three inch sizes.

If you are making up a mud system, why not build in the safety and economy of Cameron Shear-Relief Valves—almost everyone does.

Cameron

IRON WORKS, INC.

P. O. Box 1212 — Houston, Texas

Export Office: 7912 Empire State Bldg., New York City. In England: Cameron Iron Works Ltd., 76 Grosvenor St., London W. 1 England.

These contractors use Bucyrus-Erie spudders for profitable secondary recovery, cleanout work . . . You Can, Too

These men profit from the speed and mobility of Bucyrus-Erie spudders. They get forward and reverse speeds on all reels and on the catheads for accurate, split-second control; free-wheeling reels for quick lowering; fast, powerful line pulls for easy handling of tools, packers, swabs, and tubing; and mobile design for time-saving moves.

Check the jobs pictured of today's popular choices for well servicing and secondary recovery — the 60-L, 28-L, and 36-L spudders, available for skid or trailer mounting. Then visit your nearby Bucyrus-Erie distributor or write us direct for all the facts.

55558

FIRST with the FINEST in spudders

BUCYRUS ERIE

DRILL DIVISION
U. S. HIGHWAY 40 WEST,
RICHMOND, INDIANA

A 60-L owned by Gaines Drilling Co., El Dorado, Kans., cleans out a 1900-ft. well (about 40 years old) in a Cities Service water flood project west of El Dorado. Says Driller Mack Gaffney: "I like 'em. Bucyrus-Eries have a good snappy spudding motion." Driller Harley Nicholas adds: "I've worked a lot of rigs in different formations all over the country . . . and I like Bucyrus-Eries for their steady, trouble-free performance."

Owners of five Bucyrus-Erie spudders, Greer Bros., Whitesville, Ky. consider the 60-L as "the only rig for drilling in Kentucky". This 60-L is cleaning out a well in the Apex Field near Greenville. High line speeds assure rapid progress on hole after hole. Mobile trailer mounting, telescoping derrick, and folding tubular braces save time of moves.

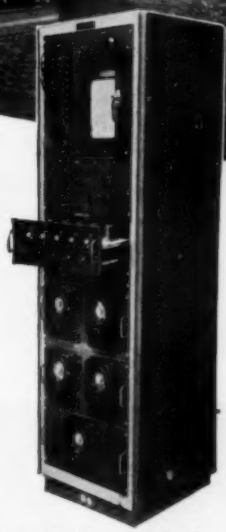
A Halliburton crew runs a Hydrofrac to increase the gas flow from a 3,113-ft. well in west central Pennsylvania. Joining in the operation, Ed E. Hess, Clarion, takes advantage of the speed, strength, and capacity of his 36-L to set casing, handle tubing, and run treatment packers.

"We had all kinds of equipment," says E. M. Hale, Ada, Okla., "but we've standardized on 28-Ls for quick moving. We worked over 23 wells in six months on a water flood project with never a breakdown for either rig." Hale (extreme right) watches his men swab fracture oil and fresh crude through perforations on a well in the Wetley Field.

Canadian Seaboard Selects BS&B

Phanto-Matic

For Lease Production Automation



With BS&B, Ltd's completion of this installation in the Pembina Field near Drayton Valley, Alberta, the Canadian Seaboard Oil Company, of Calgary, became the first producing company in Canada to achieve *full lease automation* with a BS&B PHANTO-MATIC Lease System.

The PHANTO-PUMPER unit, housed in the partially completed building at left in the picture above, automatically handles the production from four wells which are connected to the production header assembly. It is here that wells are individually switched from production to test and data recorded on a strip chart, then switched back to production again. Also included in this unit are production and test separators.

From these separators the oil goes to a 300 bbl. surge tank (at right in the picture), and then to the 25 bbl. PHANTO-GAGER (center) which does the actual measuring of the oil to the pipeline. Both the PHANTO-PUMPER and the PHANTO-GAGER are skid-mounted units and are electro-pneumatically controlled. Illustration at right shows the PHANTO-PUMPER controls console.

Auxiliary equipment includes a standby generator which is automatically started in case of power failure to the lease, an air compressor to supply air to the pneumatically operated valves and a 3-pass indirect heater to heat oil going to the two separators and through the surge tank.

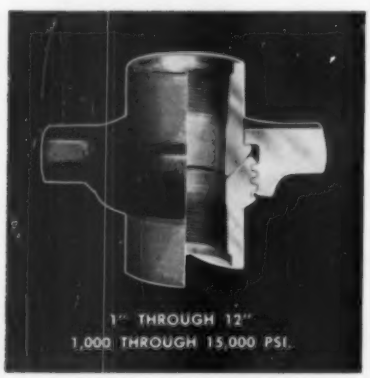
BS&B PHANTO-MATIC Lease Systems are available for handling lease production ranging from only a few wells up to a hundred or more, and may be purchased either as completely integrated systems or in component parts to supplement existing equipment. Ask your BS&B Man—or write for full information to . . .

EFFICIENCY OVER 60 YEARS RELIABILITY
BS&B
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.

Oilfield Equipment Division, Dept. 1-A3B

P.O. Box 1714 Oklahoma City, Okla.



Sold by
Supply Stores Everywhere.

"Yes, **WECO** Helped Us Cut Costs"

"You know, we really save a lot, using WECO Unions on all our rigs. We rig-up faster and spud-in quicker after moving on location. It also helps cut rig down-time because with WECO Unions we can shift equipment from rig to rig with no time lost in matching unions.

"We can get WECO Unions anywhere, too . . . that sure keeps us from having to tie-up money in spares. Not that we need replacements very often, WECO Unions seem to last forever. And those perfectly matched seats seal under all conditions, too."

Ask your WECO Representative how you can cut rig costs by standardizing with WECO Unions.

U-7-58

WECO®

WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS

Division of CHIKSAN COMPANY *a subsidiary of*
FOOD MACHINERY AND CHEMICAL CORPORATION

Vornado alone dared make this test!

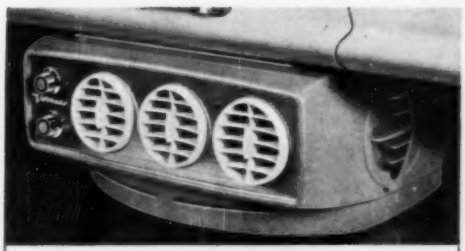
now! PROOF that AUTOMOBILE AIR CONDITIONING makes summer driving safer... healthier!

For thousands of torturous miles in sweltering heat—two matched college athletes drove from Phoenix to Yuma, Arizona, and back... EVERY DAY for 2 weeks! They alternated driving identical cars, one Vornado air conditioned, one not.

Here Are The Results! While driving the Vornado air-conditioned car, each driver felt, ate, and slept better... depth perception improved!

While driving an **identical** non-air conditioned car—each driver lost weight, complained of stomach cramps, experienced HIGHWAY HYPNOSIS, SHOWED A **DANGEROUS** LOSS OF DEPTH PERCEPTION AND SUFFERED EXTREME FATIGUE!

Vornado COOLS BETTER, TOO! The man who "lives in his car" looks better and feels better at the end of his "run." He is in better shape to carry on his work—or enjoy his leisure hours!



ONLY Vornado OFFERS ALL THIS!

- ✻ Exclusive curved cooling coil!
- ✻ Five air circulators!
- ✻ Three-speed blower control!
- ✻ Automatic thermostat!
- ✻ Giant arctic compressor!
- ✻ Install fast! Full factory warranty!
- ✻ NATIONWIDE SALES AND SERVICE!

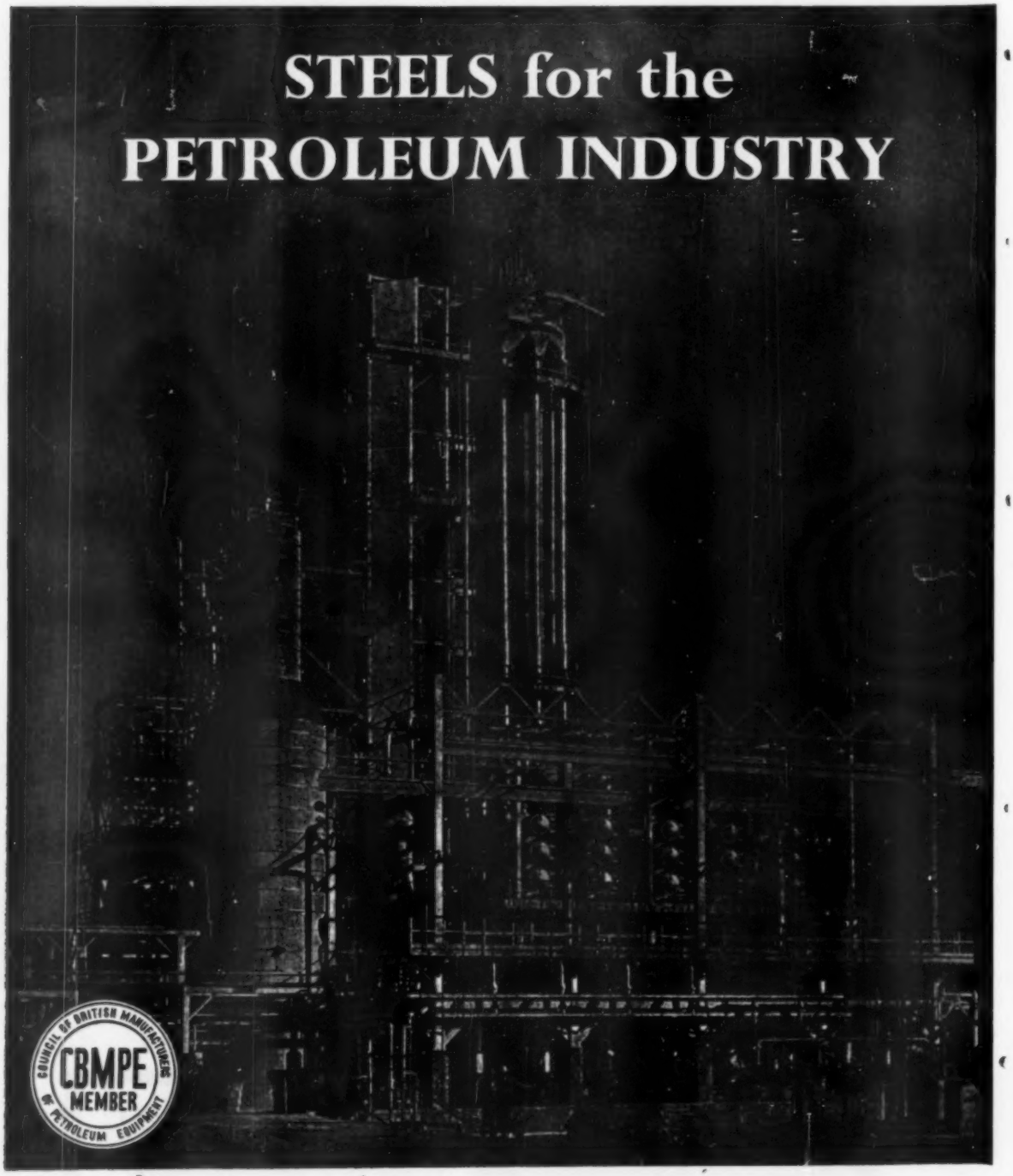
Vornado®
Automobile Air Conditioner

fleet owners! attention!
Contact us today for our special fleet program!

A product of

The O. A. Sutton Corporation, Inc., Wichita, Kansas
World's leading full line manufacturer of comfort cooling appliances

THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND



"A Symphony in Steel"—A British Petroleum Company photograph.

THE UNITED STEEL COMPANIES LIMITED, SHEFFIELD, ENGLAND

APPLEBY-FRODINGHAM STEEL COMPANY • SAMUEL FOX & COMPANY LIMITED • UNITED COKE & CHEMICALS COMPANY LIMITED
STEEL PEECH & TOZER • UNITED STEEL STRUCTURAL COMPANY LIMITED • WORKINGTON IRON & STEEL COMPANY
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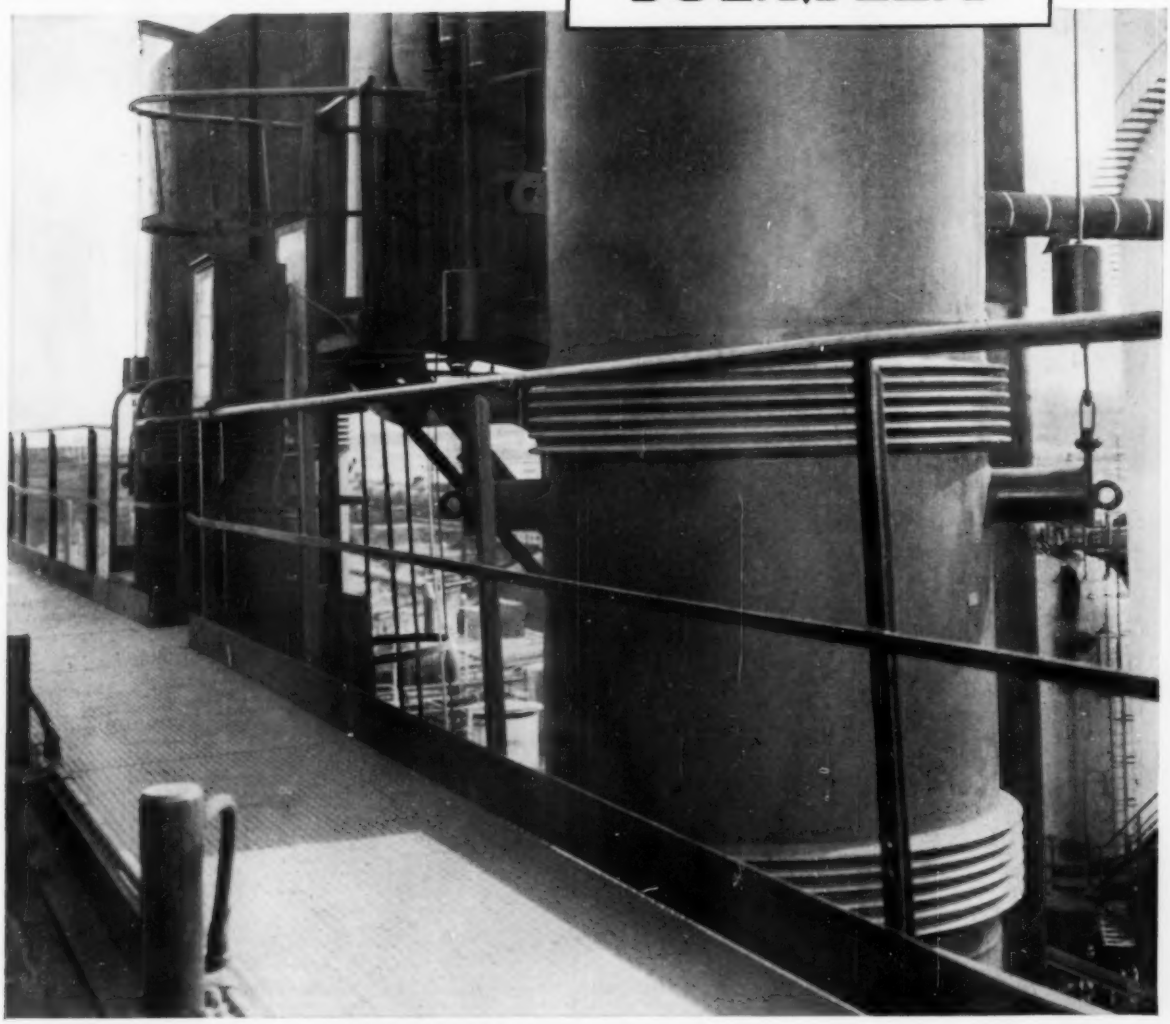
THE UNITED STEEL COMPANIES LTD

Leading firms use SOLA-FLEX®



Giant Sola-Flex joints used by Standard Oil Company in El Segundo plant

THESE RUGGED 54-inch Sola-Flex expansion joints are in service at Standard Oil Company of California's El Segundo refinery. They are an important example of why more and more of America's leading businesses – petro-chemical, power, nuclear and others – rely on Sola-Flex joints to help solve difficult temperature and pressure problems.

Solar manufactures the most comprehensive line of bellows and expansion joints in the world. They are made from a wide variety of stainless and high alloys for important nuclear, missile and industrial applications – in sizes ranging from ½ in. to 35 ft in diameter. They are built for service from –320 F to 1200 F. And they tame "hard-to-handle" pressures up to 3500 psi for special applications.

A new pamphlet describes Solar's complete line of Sola-Flex bellows and expansion joints. Write for it to Dept. D-171, Solar Aircraft Company, San Diego 12, California.

SOLAR AIRCRAFT COMPANY — SAN DIEGO, DES MOINES

Designers, developers and manufacturers of gas turbines, expansion joints and aircraft engine, airframe and missile components.

This INTERNATIONAL model VF-230 six-wheeler is built from the ground up to absorb severe shock loads – stand up under the most extreme hauling conditions. Gross vehicle weight 60,000 pounds. Other off-highway six-wheel models in conventional and COE design available with power-packed gasoline or LPG "sixes," or diesels up to 335 hp.

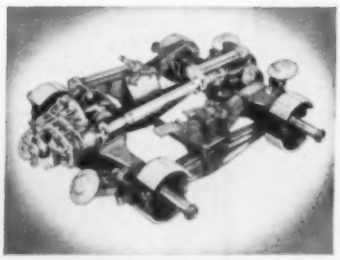
Here's the unique double-duty INTERNATIONAL Travelette with rugged 4-wheel-drive. It seats six big people in all-weather comfort in two full-width seats. Hauls up to a full ton load in its all-steel 6-ft. pickup body. Also available with standard drive or factory installed service-utility body that offers bulk load space plus time-saving compartments for tools and gear.

INTERNATIONAL TRUCKS

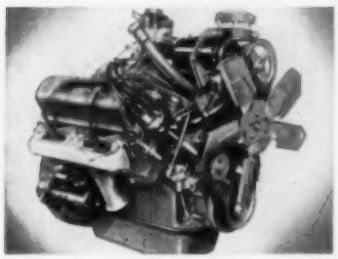
Day-after-day dependability

Just one reason why you'll find International Trucks cost least to own!

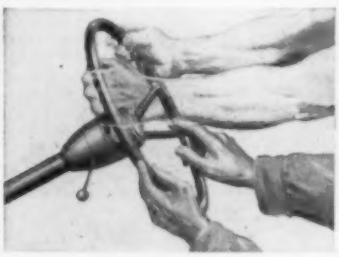
Rugged extra-heavy fenders, bumper and grille guard *built* to stand up under the most severe working conditions.



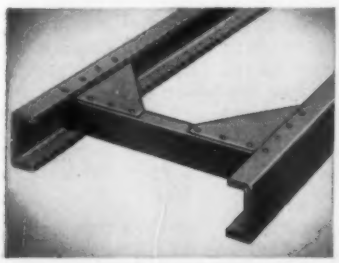
Plenty of pull with sturdy, long-lasting tandems that provide extra flotation, positive traction on any terrain.



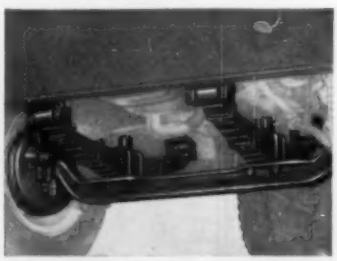
True-Truck V-8's. Rugged long-life design. 549 cu. in. displacement for more *usable* torque and horsepower.



Easy to handle even in tightest spots with true geometric power steering, cam and roller-mounted steering gears.



Plenty of strength. Heat treated alloy double channel frames have extra rigidity and proper flexibility for added life.



Maximum load and life. Heavy-duty, 15,000 lb. capacity heat treated steel front axle cuts maintenance and down time.

INTERNATIONAL Trucks are *built* to handle the big loads with ease—*specialized* on the manufacturing line to keep off-highway operations on the move day in and day out!

Extra-heavy components shrug off brutal load punishment. Heavy-duty V-8 power pulls all wheels through sand, sinkholes or mud with profit-making fuel economy. What's more, *these* True-Truck engines are backed up by a power train that matches truck, load weights and job exactly.

The result: You put more money in the bank because you haul extra-weight loads with less on-the-job cost and work-stopping down time.

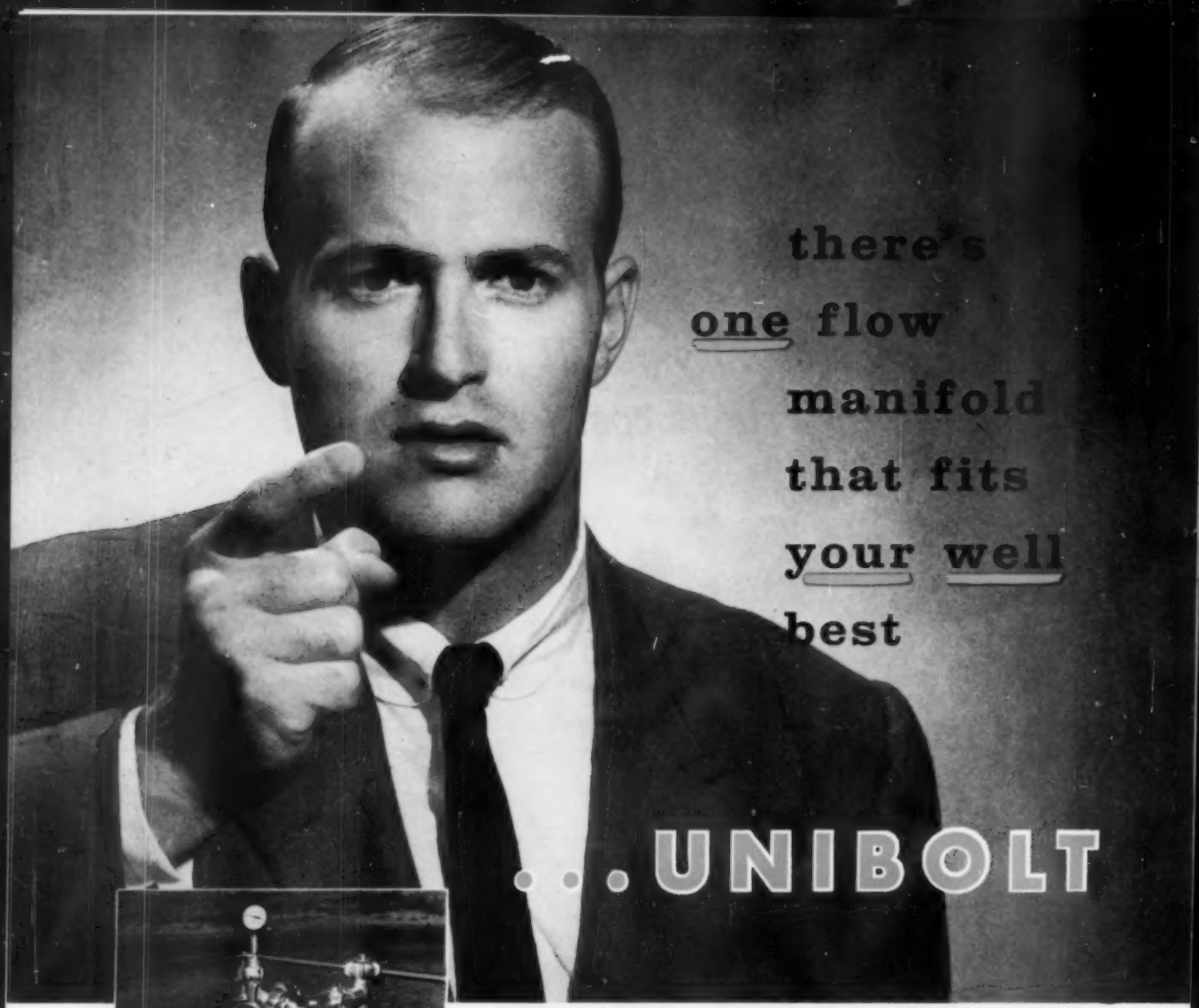
Your drivers will like them and you'll like them! See your INTERNATIONAL Dealer now. He's ready to help you choose the right truck for your job . . . the truck that costs *least* to own,* from the world's most complete truck line!

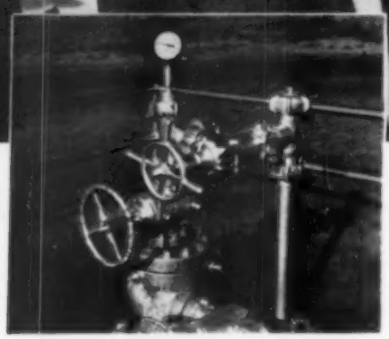
**Signed statements in our files, from fleet operators throughout the U. S., back up this statement.*

cost least to own!

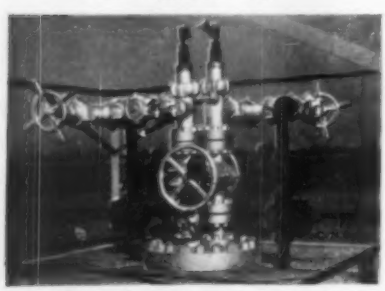
INTERNATIONAL HARVESTER COMPANY, CHICAGO

Motor Trucks • Crawler Tractors
Construction Equipment • McCormick® Farm Equipment and Farmall® Tractors





UNIBOLT Flow Manifolds are available in Tee or Cross Type, 6,000, 10,000, and 15,000 lbs. test.



UNIBOLT Flow Manifolds on a dual parallel string completion.

UNIBOLT Flow Manifolds (unlike flow controls of fixed design) permit any desired arrangement of wing valves and chokes. They may be assembled and tested at the factory to meet your exact requirements. Then, when the well goes on the pump and the Flow Manifold has served its purpose, it may be salvaged as a complete unit for use on another well, or it may be dismantled and its separate units used wherever needed. Its component parts —tee or cross, wing valve, and choke body—interchange with all other UNIBOLT products of the same size.

Remember, too, that a UNIBOLT tee or cross provides a safe, easy connection for a lubricator equipped with the mating half of a UNIBOLT coupling.

If it is your responsibility to specify Christmas tree manifolds, you'll be interested in our "24 reasons why Unibolt Flow Manifolds are better." Let us send you a copy. Write to:

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

At the Rock of Ages granite quarry in Barre, Vermont, a derrick with a bucket platform is used to lower crews to the bottom of the 360-foot quarry. With the lives of scores of men at stake they know that they can...

...lower away in safety

You may not operate derricks carrying ten-man loads or 50-ton blocks of granite, *but safety should be just as important to you.* A "bargain" rope may save you money—but if it fails it may cost more than you bargained for. Buy rope on the basis of quality—buy Wickwire Rope.

CF&I

WICKWIRE ROPE
A CF&I PRODUCT

LOOK FOR THE **YELLOW** *TRIANGLE*

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

THE COLORADO FUEL AND IRON CORPORATION—Albuquerque • Amarillo • Billings • Boise • Butte • Denver • El Paso Farmington (N.M.) • Fort Worth • Houston • Kansas City • Lincoln (Neb.) • Odessa (Tex.) • Oklahoma City • **Phoenix** • **Pueblo** Salt Lake City • Tulsa • Wichita • **PACIFIC COAST DIVISION**—Los Angeles • Oakland • Portland • San Francisco • **San Leandro** Seattle • Spokane • **WICKWIRE SPENCER STEEL DIVISION**—Boston • Buffalo • Chattanooga • Chicago • Detroit • Emlenton (Pa.) New Orleans • New York • Philadelphia

INTRODUCING THE 88

A NEW CONCEPT IN THE MANUFACTURE OF EXTRA HEAVY DUTY SNATCH BLOCK

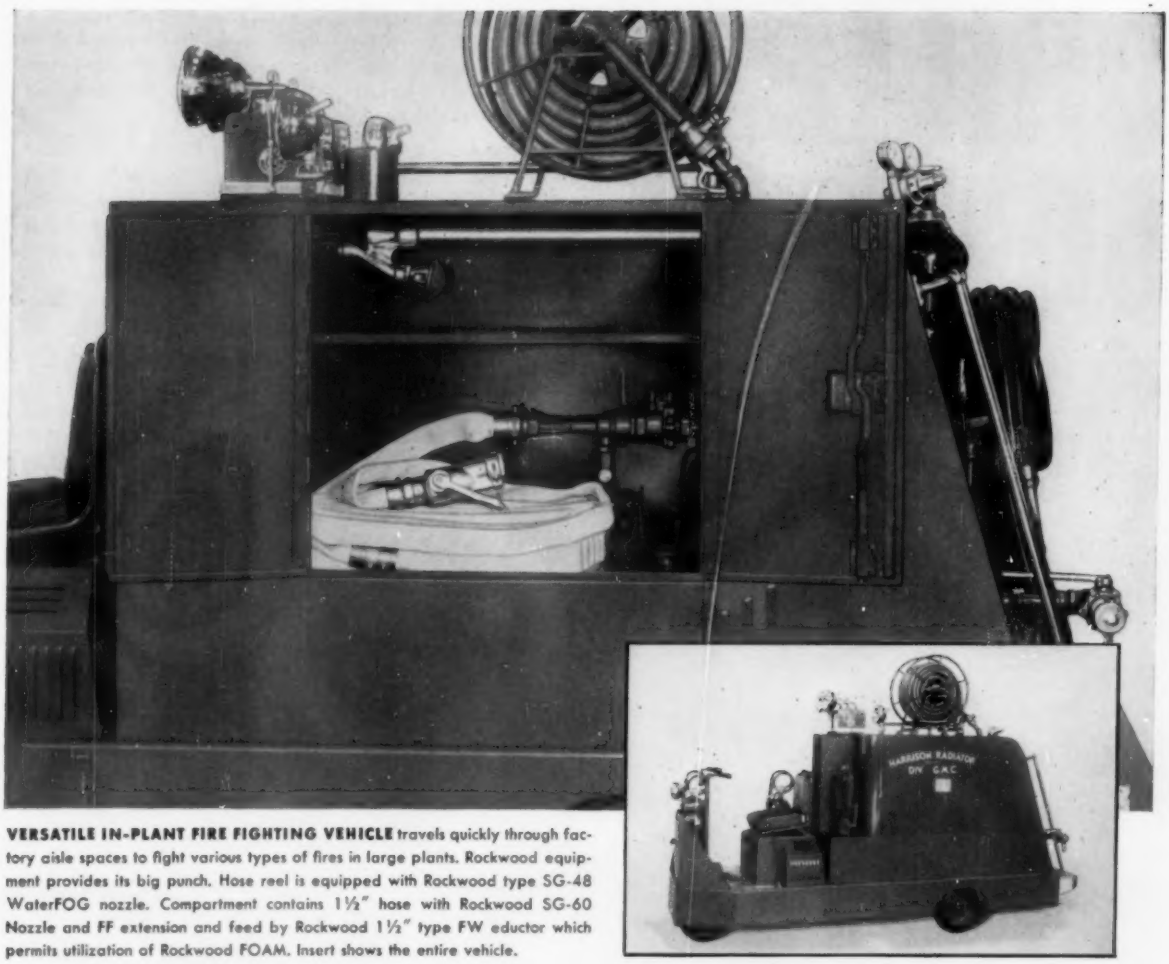
The specially heat-treated alloys used create a lightweight with a heavyweight's "punch"!

8-inch Sheave
80,000-lb. Safe Working Capacity
Only 54 Lbs. Total Weight

- Entire block cad-plated to prevent any deterioration under adverse conditions.
- Every component in the entire block made from a selected high alloy steel, heat-treated for optimum strength characteristics.
- Extra large (2½-inch diameter) center pin means bearing capacities matched to block's high strength.

McKISSICK

McKISSICK PRODUCTS CORPORATION
Box 2496 Tulsa, Oklahoma



VERSATILE IN-PLANT FIRE FIGHTING VEHICLE travels quickly through factory aisle spaces to fight various types of fires in large plants. Rockwood equipment provides its big punch. Hose reel is equipped with Rockwood type SG-48 WaterFOG nozzle. Compartment contains 1½" hose with Rockwood SG-60 Nozzle and FF extension and feed by Rockwood 1½" type FW eductor which permits utilization of Rockwood FOAM. Insert shows the entire vehicle.

The Inside Story of the Potent "Youngster"—a New In-Plant Fire Fighter

The Young Fire Equipment Corporation of Buffalo, New York, made this vehicle an even more potent fire fighter by installing Rockwood fire prevention equipment.

Here's How It Works

Rockwood FOAM is automatically proportioned (97 parts water to three parts FOAM) and introduced into the hose line by the Rockwood FW eductor. The Rockwood SG-60 WaterFOG nozzle fights fire five ways — by means of a solid water stream high-velocity WaterFOG, low-velocity WaterFOG from applicator, and from FF extension inserted in nozzle, a wide angle FogFOAM pattern and a solid FOAM stream.

Send For Full Information

Rockwood's wide variety of fire fighting equipment is engineered to quickly, safely control fires. Fill in the coupon below now.

Tested and listed by Underwriters Laboratories, Inc. Distributors in all principal industrial areas.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

Distributors in all principal industrial areas

ROCKWOOD SPRINKLER COMPANY
Portable Fire Protection Division
2070 Harlow Street
Worcester 5, Mass.

Please send me your illustrated booklet on Rockwood fire fighting products.

Name.....

Title.....

Company.....

Street.....

City.....*Zone*...*State*.....

DRILLED 50 HOLES IN 2½ YRS

Since he Switched to "Jimmy" Diesels

If you're going to make money with a "slim-hole" rig, you've got to move fast—can't be lugging around dead iron. So it pays to use "horse sense" picking your horsepower—as T. J. Johnson Drilling Company did when they switched to GM Diesel.

Superintendent A. B. Irion says, "The GM packs a lot of power in less weight making them a perfect match for this highly portable type rig. That's the first big reason for our choice of GM—lower initial cost is the other." Look at this rig's record: *More than 50 holes drilled in 2½ years' continuous operation—over 300,000 feet with no major repairs.* And Mr. Irion, who had formerly used butane engines, reports fuel savings, too. Cost of fuel and lube with the "Jimmys," $62 a day compared to $100 a day with butane.

No question about it—you make hole faster at less cost with "Jimmy" Diesels because these work-loving 2-cycle engines respond to load instantly. They're smoother! They're compact—easy to move! *And they cost less per horsepower to buy—and to maintain!* Ask any owner—then call your GM Diesel distributor. He wants to help you pocket a profit!

DETROIT DIESEL ENGINE DIVISION OF GENERAL MOTORS, DETROIT 28, MICH.

Regional Offices: New York, Atlanta, Detroit, Chicago, Dallas San Francisco

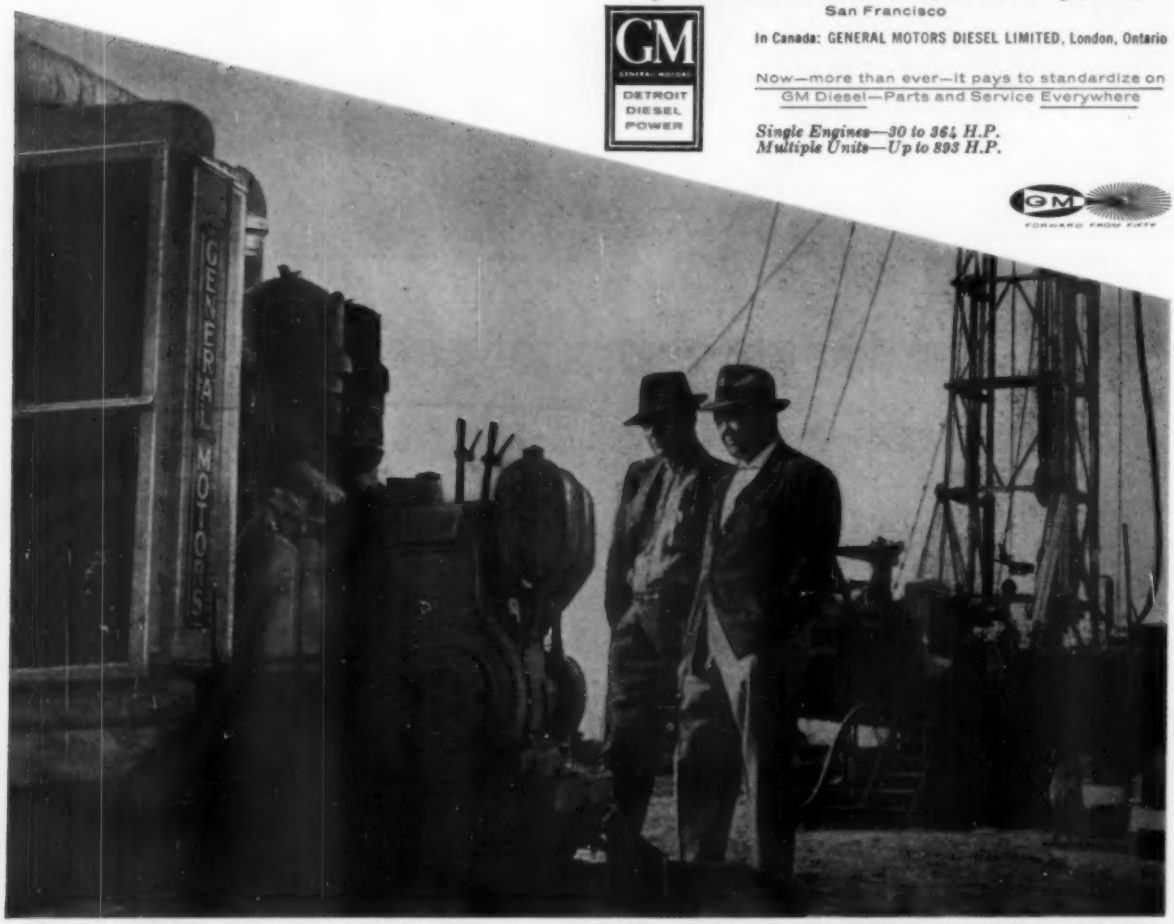
In Canada: GENERAL MOTORS DIESEL LIMITED, London, Ontario

GM DETROIT DIESEL POWER

Now—more than ever—it pays to standardize on GM Diesel—Parts and Service Everywhere

Single Engines—30 to 364 H.P.
Multiple Units—Up to 893 H.P.

GM FORWARD FROM FIFTY

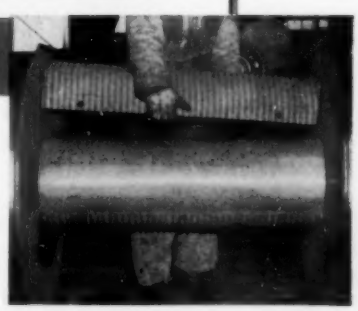


T. J. Johnson Drilling Co., Tyler, Texas, operates two "slim-hole" rigs—both powered by GM Diesels. Rig shown has a "6-110" driving Wilson Mogul Torque Aire draw works; a "Twin 6-71" on a 7½" x 14" Emsco D-300 mud pump; a "6-71" on a Bethlehem standby pump. Average depth per hole, 5800'; maximum depth thus far, 7500'.

LEBUS SPOOLING

FOR ALL TYPES OF HOISTING UNITS

In addition to the standard grooved segments, LeBus provides a complete stock of Machine Grooved Split Adapter Sleeves for all sizes up to 2¼" line and to fit up to a 36" "Drum" core for quick installation anywhere. This grooving is ideal for many types of drum grooving. For example, units already in operation requiring a line size change can quickly be converted with LeBus Split Adapter Sleeves. If two different size lines are used a removable sleeve can be installed. The LeBus Split Adapter Sleeve Grooving installation is flexible to meet any situation and may be easily and expertly bolted or welded by any good mechanic. Write today for complete details . . . enjoy trouble-free spooling this fast, easy way!

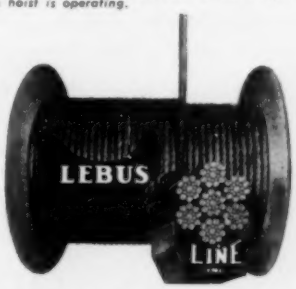


The above pictures a mechanic preparing to fit the second half of a machine grooved Split Sleeve or adapter for drilling and bolting. A Split Sleeve can be more easily welded. These installations can be made in factory, storage yard or on the job where hoist is operating.

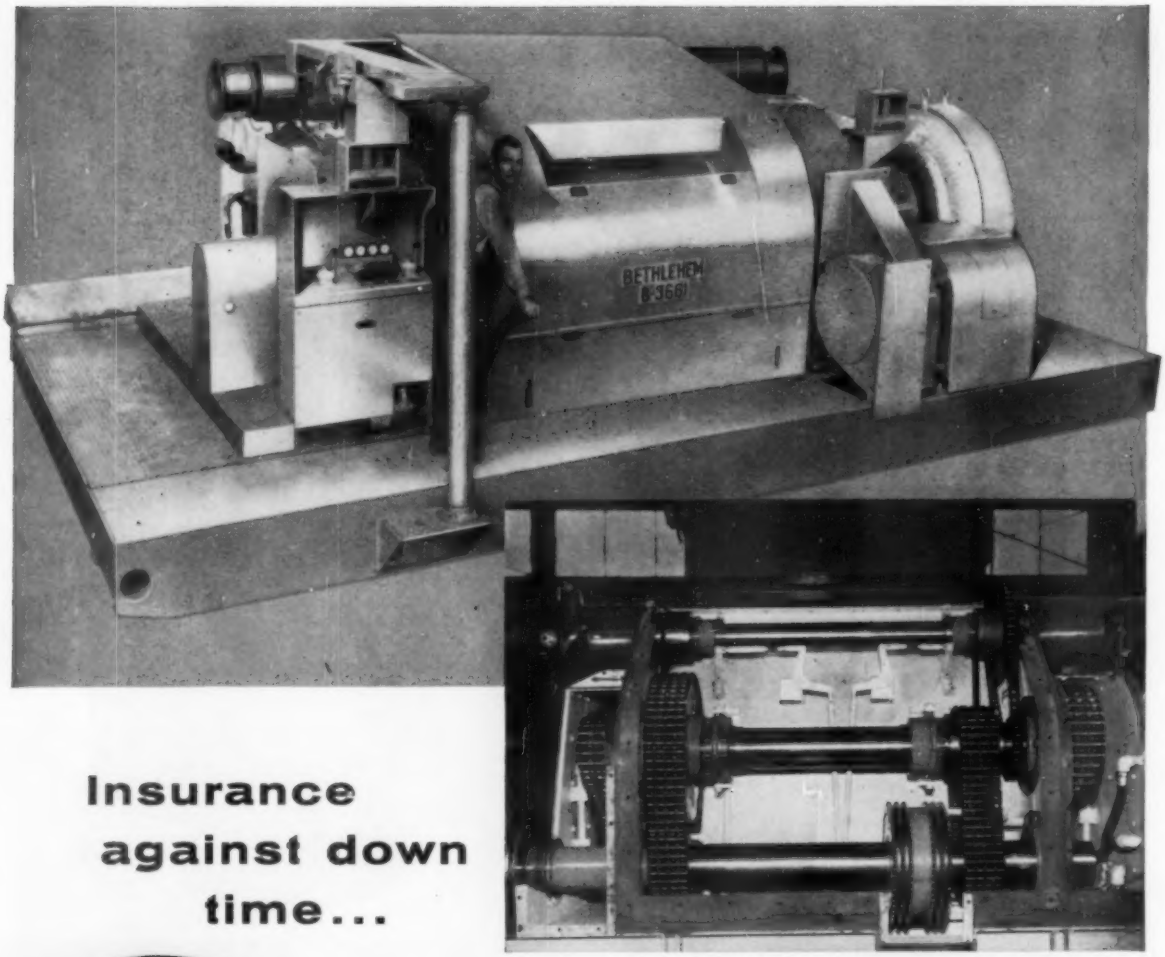
"The Finest is Counterbalance"

WRITE FOR THE NEW 4TH EDITION OF THE LEBUS WIRELINE SPOOLING HANDBOOK . . .
Just off the press!

LeBus International Engineers, Inc.
LONGVIEW, TEXAS



LEBUS . . . WORLD HEADQUARTERS FOR *Engineered Spooling* COUNTERBALANCE - PYRAMID - HELICAL



Insurance against down time...

REX® in the Bethlehem Drawworks

The Bethlehem Supply Company B-3661 Drawworks here pictured is equipped with Rex Roller Chain—for one reason. Nothing less than the best of chain is good enough to meet the driller's demand for reliable service, low upkeep and minimum down time.

In appearance, Rex Roller Chain is not too unlike other good roller chains. The design and manufacturing features which result in Rex superiority won't show in a photograph of a chain drive.

For instance, Rex designers have developed a revolutionary system of precision pitch control to equalize load distribution over all parts. Each link plate carries its share of the load.

Link plate holes, too, come in for special attention. A special manufacturing process imparts tremendous strength at these vital points.

And Rex Roller Chain is easy to couple and uncouple because of Rex "Glide-Fit" design.

Whatever your rig, you'll get maximum performance and profit out of it if you specify Rex Roller Chain. See your supply store or your CHAIN Belt Field Sales Engineer. CHAIN Belt Company, 4619 West Greenfield Avenue, Milwaukee 1, Wisconsin.

CHAIN BELT

Milwaukee 1, Wisconsin

Oil Field Offices: Dallas, Houston, Los Angeles, Odessa, New Iberia, Oklahoma City, New York
Export Offices: Milwaukee, New York

Anti-lock prevents relative rotation between anchor cage and tubing while running

Re-latch threads prevent upper slips from setting until ready.

Long, flexible drag springs allow easy recovery in case of washover.

Special seal protects against fouling from sand or scale.

Internal shoulder creates a differential piston inside rubber to cause a tighter seal.

Full setting force is transmitted to packing element through lower head. No scrubbing action between lower slips and casing wall during setting stroke.

Guiberson
permanent completion

TYPE A DRILLABLE PACKER

runs and sets easily, quickly

- ***Built-in safety against premature setting***
- ***Set and produce in ½ tubing trip***
- ***Unequalled rubber seal***

Guiberson Type A Drillable Packer gives you a versatile packer for many uses..single or multiple zone production, acidizing, pressuring operations, water-flooding, testing, corrosion control and many others.

New safety factors against premature setting are provided since the transmitting of drag from tight casing or impact from junk is direct to the tubing string.

The Type A can be set and placed in production with only ½ tubing trip. Spacing problems are easier, especially when run in combination with a multiple zone packer. From rig floor to completion, the Type A runs and sets faster than any other permanent packer.

Guiberson superior quality rubber and special lead-alloy thimbles compress fully for a leak-proof seal. Setting is quick, easy and uncomplicated..may be set by wire line. Available in 5" through 7⅝" sizes for 2" or 2½" tubing with a full line of stingers and accessories. Ask your Guiberson representative for a recommended installation or write for full details.

THE GUIBERSON CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A

Sold by
Oil Field Supply Stores
Everywhere

AMERICAN PETROLEUM INSTITUTE
REFINERY DIVISON
CONVENTION
LOS ANGELES
MAY 12 TO 15

you get
EXTRA CARE
all the way there...
on UNITED,
the Radar Line

UNITED AIR LINES

For information and reservations,
call United or an authorized travel agent.

They Say—

Pure Oil's Maracaibo wells

Dear Sir:

Dr. Irizarry's March 3 article ("Venezuela Today," p. 66) erred in stating that the Signal-Pure-Sohio-Hancock group has two dry holes in its concession in Block 4 of Lake Maracaibo. A similar error was made on the map on page 67 accompanying the article.

Drilling on the group's first well—the Centro Lago 1-X—was suspended at 9,470 ft. The principal sands that had been encountered were found too near water to justify testing at that time. It was not drilled deep enough to encounter the Eocene producing zones found in the Centro Lago 2-X and 3-X wells. The group plans to deepen the 1-X well at a later date.

The dry hole shown on the map in the northwest corner of Block 4 has not been drilled. It is merely a future location.

Gordon H. Ewen
Pure Oil Co.
Chicago

Texas best for wildcats?

Dear Sir:

I wonder whether or not you could possibly answer this question for me . . . Assuming all other facts are equal, what incentive would anybody have to drill in Oklahoma rather than Texas?

As I understand it, in the event a wildcat well is brought in as a producer in Texas, then, depending on the depth, that well will be allowed a "discovery allowable" for 18 months. As it was explained to me, assuming that the well is brought in at 5,500 ft., the daily discovery allowable will be 100 bbl., and this may be produced every single day of the month (not just 11 days or 12 days, but every single one of the 30 or 31 days within the month for a full 18 months. On this basis the well could be operated for 548 consecutive days at 100 bbl. per day, or a total of 54,800 bbl. of oil could be produced. (I am assuming that the well can produce at least 100 bbl. per day).

Given the same facts, I understand that if the well were located in Oklahoma then there is no such thing as a discovery allowable. The well would be given a daily allowable depending again on its depth. At about 5,500 ft. depth, I understand that this would run somewhere around 26 to 28 bbl. per day. Assuming that it were 26 bbl. per day, then, for the same 548 days only a total of 14,248 bbl. would be produced over the same 18-month period as against 54,800 bbl. which could be produced in Texas . . . a difference of 40,552 bbl.

We are so impressed with this difference in treatment that we are inclined to think that Texas is the only place in which to go wildcatting . . . It would seem to us that the Oklahoma operators would feel themselves at a competitive disadvantage with Texas operators. . . .

J. Stanley Halperin
Law Offices
New York.

(Editor's note: There are many pros and cons for exploring in either Texas or Oklahoma. If your program is properly set up, you can justify operations in either state.)

Sterba article appreciated

Dear Sir:

We don't follow the practice of thanking publications for coverage of our activities, believing that if what we do is newsworthy it deserves description and if it isn't, it shouldn't have been printed.

Nonetheless, we would like to thank the Journal for recognition of our public-relations work in connection with the Sterba well (O&GJ, Feb. 17, p. 74). No favor was asked or granted, but we appreciate it just the same.

Incidentally, my congratulations on your new headquarters. Looks like a fine set up. . . .

H. T. Fort
Manager, Public Relations
Magnolia Petroleum Co.
Dallas

Boston Herald likes gas bill

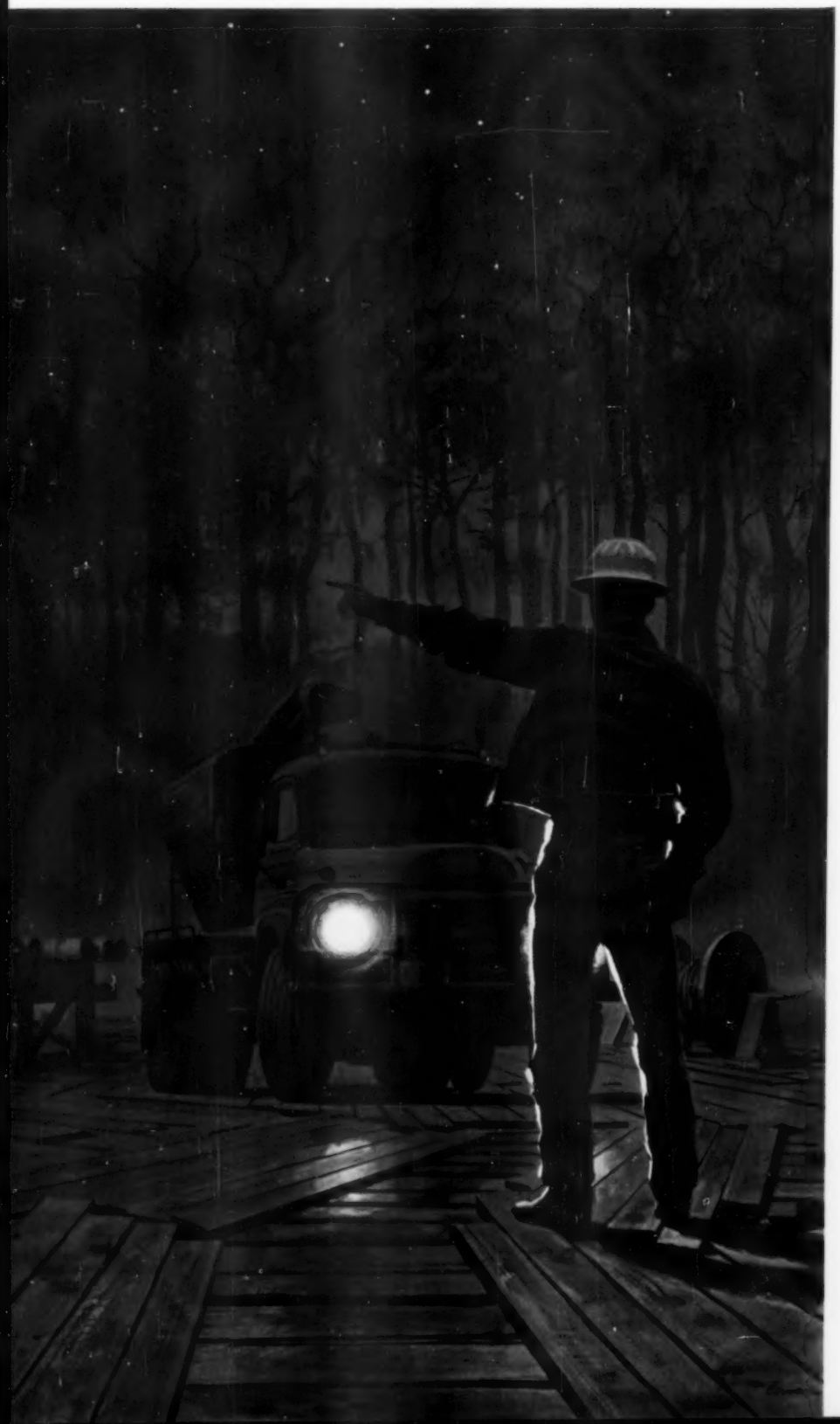
"A utility-type regulation of gas producers would indeed introduce something new to this country. The pipeline companies and the local distributors are publicly protected monopolies and, of course, should be regulated. But there are some 4,100 producers selling gas in interstate commerce.

"Nowhere do we now require regulation where any such competition exists.

"In fact, utility-type regulation would be terrificly difficult because of the complexity of gas production. . . .

"There are more royalty owners than there are producers and under regulation any royalty owner might insist on payment of his royalty in

With Magcobar on your well ...



you get the right products when you need them

Wherever you drill there's a Magcobar dealer close by. His job is to help make drilling your well as routine as possible. But, when the unforeseen happens, he is ready to pitch in even harder.

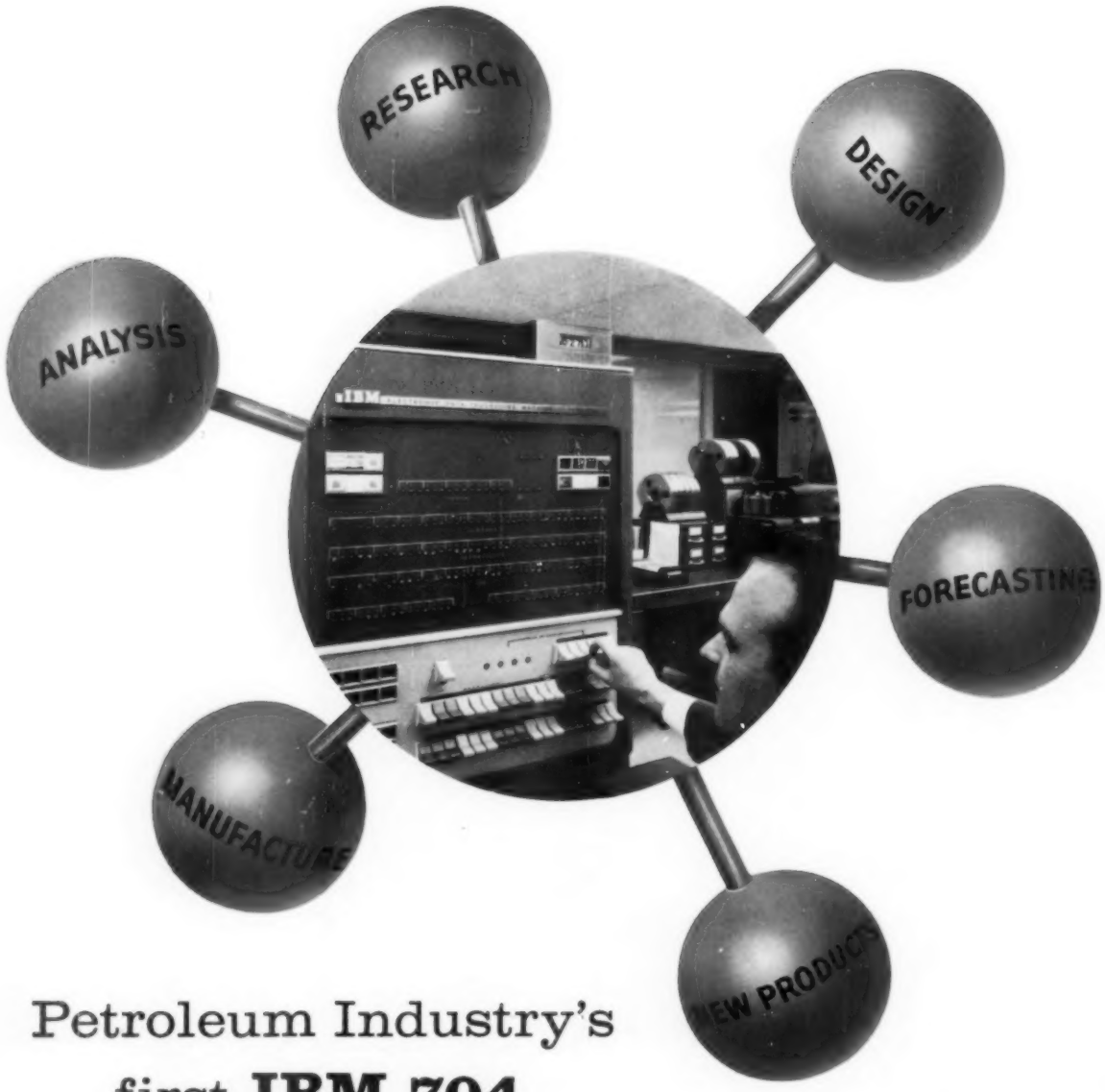
The Magcobar dealer stocks the emergency materials you might need. He has the facilities to get them to your well when you need them. To get them there fast.

This extra degree of service from the Magcobar dealer is one more reason why it pays to use Magcobar. When the Magcobar team is working for you you get the industry's best qualified mud engineers, the best drilling muds and chemicals — at your well when you need them. Be sure Magcobar is on your next well. Start planning now.

Magnet Cove Barium Corporation
Houston, Texas

Magcobar
Complete
DRILLING MUD SERVICE

58-103



Petroleum Industry's first **IBM 704**

–installed by Standard Oil of California

Just a few months ago, the Standard Oil Company of California put the petroleum industry's *first* IBM 704 to work.

Today, this electronic computer is active in all phases of SOCAL's operation. From pure research to production and marketing, the 704, which performs 40,000 mathematical operations every second, is solving problems that would otherwise be impossible to attempt.

For the story of how the IBM 704 can help your company, call your local IBM Representative, or write: PETROLEUM DEPARTMENT A58-a, IBM Corporation, 590 Madison Ave., New York 22, New York.

EXPLORATION • PRODUCTION • REFINING • TRANSPORTATION • MARKETING

IBM DATA PROCESSING

gas, which he could sell within the state outside of federal regulation.

"There is not even any precedent for regulating suppliers of utilities . . . Nor is there any substantiated evidence that producer regulation would hold gas prices down to the consumer . . .

"The bill has been muddied by an oil lawyer's campaign offer to Senator Case of South Dakota in 1956 and by the Republican dinner of a few weeks ago. But dubious and maladroit actions by some supporters do not affect the merits of the bill. You can be wrong trying to do right.

"The natural-gas bill ought to pass because, among other reasons, we still like free enterprise and don't want to substitute government control for operations of a competitive economy."

Editorial in the Boston Herald.

Why not unlimited imports?

Dear Sir:

In your March 10 issue there appeared an article entitled "Import Policy Forming."

What is the theory behind the proposals to limit oil imports? It would appear to me, as a layman, that it would not only be advantageous to our oil companies, but to the Government as well, to allow unlimited imports.

Our domestic oil supplies are still quite large, but they are not going to last forever. Why not conserve our own resources while drawing on foreign oil supplies which are owned by our own American companies?

This is not a case of imports which are produced more cheaply in foreign countries hurting domestic producers; this is a case of domestic producers importing a product which they own in foreign lands, so how could it possibly "be deemed to endanger domestic security"?

Would you please enlighten me as to the reasoning behind all this?

Paul V. Houriet, Jr.
6623 West Center St.
Milwaukee 10.

CALENDAR

APRIL

1-3 University of Oklahoma, fifth annual conference on corrosion control, Extension Study Center, Norman, Okla.

2 Petroleum Equipment Suppliers Association, eastern district meeting, Duquesne Club, Pittsburgh.

8 American Institute of Chemical Engineers, Philadelphia-Wilmington section, University of Pennsylvania, annual meeting, University of Pennsylvania campus, Philadelphia.

8-9 Gas Compressor Institute, sponsored by University of Kansas and Southwest Kansas petroleum industry, Randall's Cafeteria, Liberal, Kans.

9-11 American Petroleum Institute, Division of Production, Mid-Continent district meeting, Biltmore Hotel, Oklahoma City.

13-18 American Chemical Society, national meeting, San Francisco.

15-17 University of Oklahoma, thirty-fourth annual gas measurement short course, North Campus, Norman, Okla.

15-17 National Petroleum Association, fifty-fifth semiannual meeting, Hotel Cleveland, Cleveland.

15-18 American Welding Society, annual meeting and welding show, Kiel Auditorium, St. Louis.

16-18 Natural Gasoline Association of America, annual convention, Baker and Adolphus Hotels, Dallas.

17 Petroleum Equipment Suppliers Association, Pacific district meeting, Beverly-Hilton Hotel, Los Angeles.

17-18 Texas Technological College, fifth annual West Texas oil lifting short course, Lubbock, Tex.

17-18 American Institute of Mining, Metallurgical, and Petroleum Engineers, Louisiana-Arkansas, East Texas, and Mississippi petroleum sections, gas technology symposium, Shreveport, La.

17-18 Geophysical Society of Tulsa, Tulsa Geological Society, annual midwestern exploration meeting, Tulsa.

17-19 American Institute of Mining, Metallurgical, and Petroleum Engineers, Pacific Northwest regional conference, Spokane, Wash.

17-19 San Angelo, Tex., Geological Society, third biannual field trip, Brownwood Hotel, Brownwood, Tex.

20-23 American Institute of Chemical Engineers and Chemical Institute of Canada, chemical engineering division; Canada-U.S. chemical engineering conference, Montreal.

21-23 American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Cosmopolitan Hotel, Denver.

23-25 Second International Williston Basin Symposium, sponsored by Saskatchewan Geological Society and North Dakota Geological Society, Regina.

27-30 American Association of Petroleum Geologists, Rocky Mountain section, Casper, Wyo.

28-29 University of Oklahoma, third annual conference on automatic control in the petroleum and chemical industries, Oklahoma Memorial Union Building, Norman, Okla.

28-29 Independent Petroleum Association of America, mid-year meeting, Sherman Hotel, Chicago.

28-30 Southern Gas Association, annual convention, Dallas.

29-May 1 Petroleum Industry Electrical Association, Petroleum Electric Supply Association, annual joint meeting, Adolphus Hotel, Dallas.

MAY

5-6 Society of Petroleum Engineers of AIME, North Texas section, secondary-recovery symposium, Wichita Falls, Tex.

5-7 Purdue University, thirteenth annual industrial waste conference, Purdue Memorial Union Building, Lafayette, Ind.

5-9 American Gas Association, distribution, production, and transmission conference, Roosevelt and Commodore Hotels, New York.

7-9 American Petroleum Institute, Division of Production, eastern district meeting, Deshler-Hilton Hotel, Columbus, Ohio.

8-9 Texas Petroleum Research Committee, eleventh oil recovery conference, symposium on "A Century of Texas Oil, 1875-1975," University of Texas, Austin.

11-14 Texas Independent Producers and Royalty Owners Association, annual membership meeting, San Antonio, Tex.

12-14 Chemical Institute of Canada, National Research Council, eighth Canadian high polymer forum, Macdonald College, St. Anne de Bellevue, Quebec.

12-14 Instrument Society of America,, symposium of analysis instrumentation division, Shamrock Hilton Hotel, Houston.

12-15 American Petroleum Institute, Division of Refining, midyear meeting, Statler Hotel, Los Angeles.

12-15 American Society of Mechanical Engineers, oil and gas power division conference, Bellevue-Stratford Hotel, Philadelphia.

20-22 Pennsylvania Gas Association, annual meeting, Pocono Manor Inn, Pocono Manor, Pa.

21-22 Western Petroleum Refiners Association, Southwest regional technical-industrial relations meeting, Hotel Paso del Norte, El Paso, Tex.

21-23 Rocky Mountain Oil and Gas Association, thirteenth annual convention, Cosmopolitan Hotel, Denver.

21-23 American Petroleum Institute, Division of Marketing, midyear meeting, Roosevelt Hotel, New Orleans.

22-23 American Petroleum Institute, Division of Production, Pacific Coast district meeting, Biltmore Hotel, Los Angeles.

26-28 Chemical Institute of Canada, annual conference and exhibition, Royal York Hotel, Toronto.

27-29 Annual Short Course in Gas Technology, Texas College of Arts and Industries, Kingsville, Tex.

JUNE

2-4 Petroleum Electric Power Association annual meeting Texas Hotel, Fort Worth.

5-7 National Oil Scouts and Landmen's Association, annual meeting, Mayo Hotel, Tulsa.

8-11 American Petroleum Institute, Division of Transportation, annual tanker conference, Greenbrier Hotel, White Sulphur Springs, W. Va.

10-12 Appalachian Underground Corrosion Short Course, School of Mines, West Virginia University, Morgantown, W. Va.

19 Pennsylvania Grade Crude Oil Association, annual meeting, Penhills Club, Bradford, Pa.

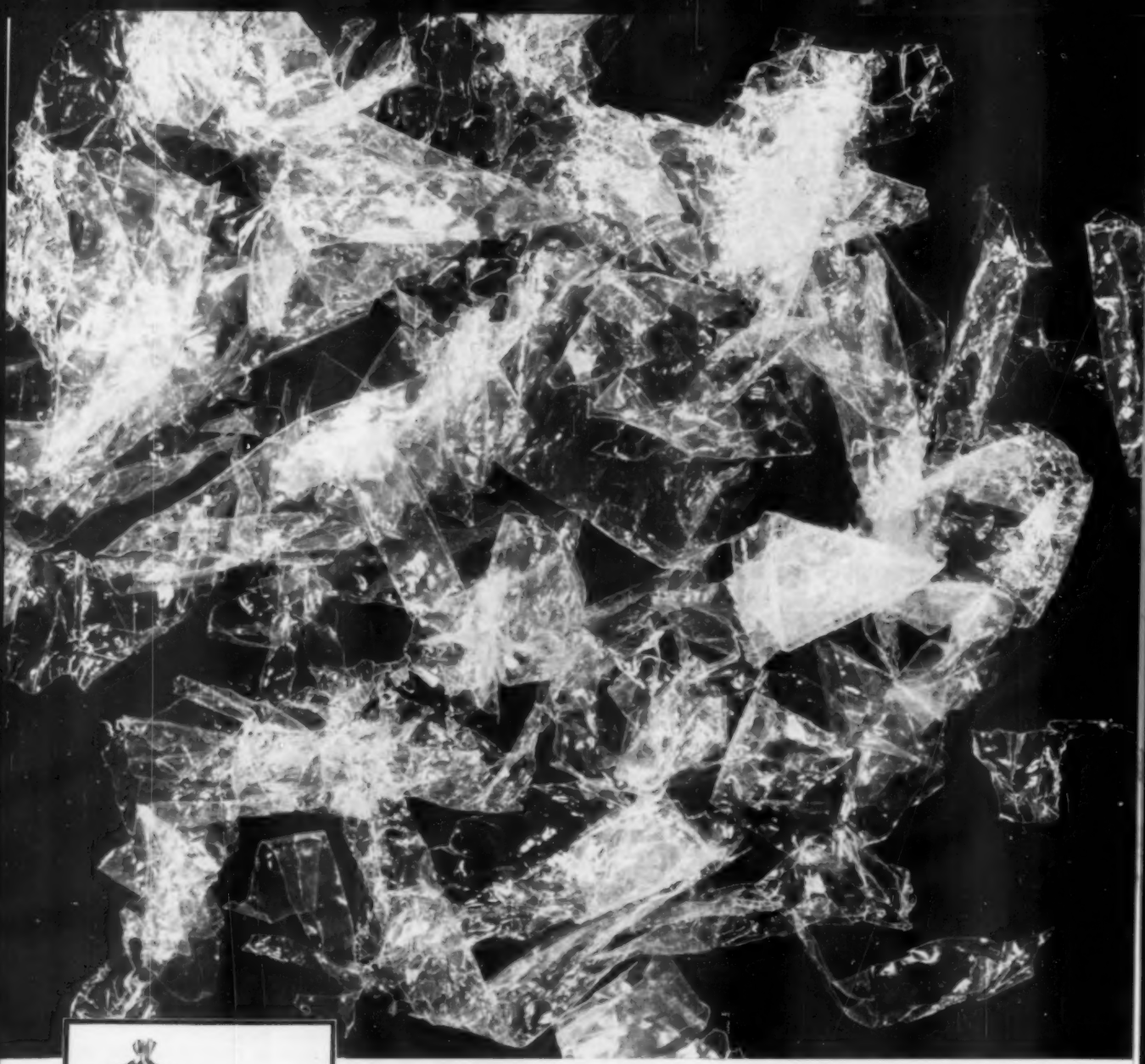
23-25 Interstate Oil Compact Commission, midyear meeting, Hotel Utah, Salt Lake City.

25-26 Western Petroleum Refiners Association, Mid-Continent regional technical-industrial relations meeting, Broadview Hotel, Wichita.

24-27 Canadian Gas Association, fifty-first annual meeting, Manoir Richelieu, Quebec.

22-27 American Society for Testing Materials, annual meeting and exhibit, Hotels Statler and Sheraton-Plaza, Boston.

28-July 2 Petroleum Equipment Suppliers Association, twenty-third annual meeting, Chateau Frontenac, Quebec.



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JOURNALLY SPEAKING

Glen(n)p(P)ool

FUNNY what peculiar bypaths some people will get off onto when they start doing historical research.

Us, for instance. For the past several weeks we have been digging into ancient history of the oil industry. (We'll tell you more about that later on).

In due course we came to November 22, 1905, when a well was drilled on the Glenn farm near the little village of Tulsa, Indian Territory. The field it discovered turned the world's oil industry topsy-turvy, boosted half a dozen small operators into major oil companies, made Oklahoma a state, and made Tulsa the Oil Capital of the world.

Well. That's all been written up dozens of times. What intrigued us was the fact that no two books called the development by the same name. We found it variously Glenn Pool, Glen pool, Glennpool, Glenpool, and Glennpool field. (So far no Glenn field pool or Glenpool pool.)

So we consulted the Oklahoma Nomenclature Committee and came away more confused than before. Its records show that "Glennpool Field" was adopted in 1935 and was never officially changed. But since 1955 its listing has been "Glenpool Field," with no explanation for dropping the "n."

There is a little country-store post office there called "Glenpool," and the committee's rule is to adopt the name of a nearby town when practical. But was "Glennpool" a misspelling in 1935, or was "Glenpool" a typographical error in 1955? Nobody knows.

Facts are that the discovery well was officially the No. 1 Ida E. Glenn, because the land was leased from the wife of Robert Glenn (two "n's") and that for many years the field was universally referred to as Glenn Pool.

Apparently it was that cute contraction "Glenpool" for the post office name that began to throw people off. Years later along came the nomenclature committee with a determination to get uniformity and a dictum that a producing area like this one is a "field," not a "pool." Nobody had ever said "Glenn field," and besides the committee has a rule against using the name of any person, living or dead, if it can find a way out. The little post office gave it an out.

So officially it's the redundant title of "Glenpool Field" (or is it "Glennpool Field"?). To our ears it sounds sort of silly to use both "pool" and "field" in the same title. Nowhere in the literature could we find mention of any other oil-producing spot in the whole world with both "pool" and "field" in the name.

It was Glenn Pool to the oil industry before either the post office or the nomenclature committee was established. And it's still called Glenn Pool (without the "field" added) by most oilmen in these parts, the Oklahoma Nomenclature Committee to the contrary notwithstanding.

So what should a great truth-loving, accuracy-seeking, recognized authority like the Big Yellow Book do? Well, in the past we have been as confused as everybody else, and we have used every possible spelling and combination.

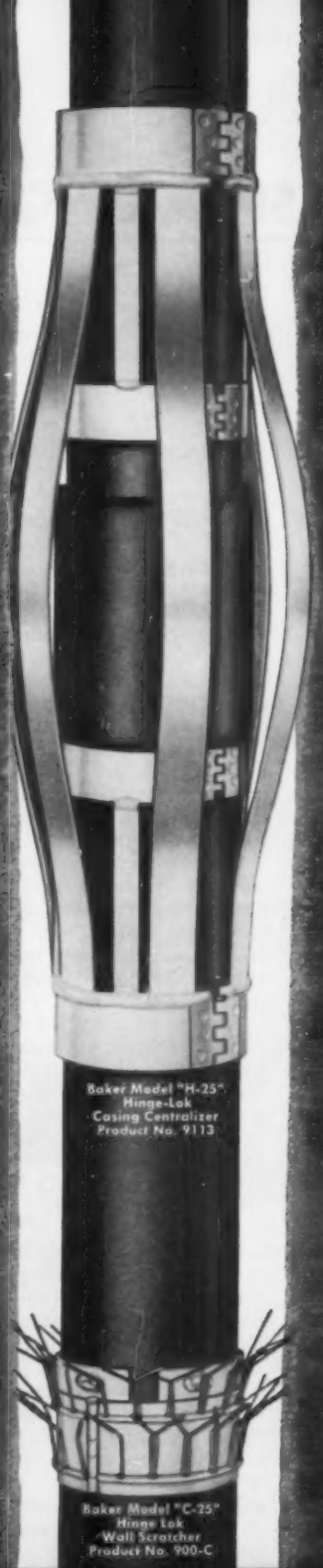
For our part, we like the solution reached by no less a meticulous and style-conscious publisher than the Harvard University Press. In a big book on the oil industry it consistently says "the Whatsis field" (lower-case "f") and "the Soandso pool of the Whatsis field" (lower-case "p"), but always Glenn Pool (no "the," and upper-case "p").

This puts Glenn Pool in a class by itself. And what's wrong with that? Consistency is the hobgoblin of little minds. Glenn Pool was unique in its day, and it had such revolutionary effects on the entire oil industry that it is entitled to live on in history as the only one in Oklahoma named "pool" instead of "field."

Them's our sentiments, and they are echoed by one of the men we talked with about it, who said:

"Please don't settle the issue. Like the oil industry itself, it's the uncertainty that makes Glen(n)p(P)ool a subject worth talking about."

—*Henry D. Ralph.*



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Study is needed on waterflood proration

THE recurrent question of whether waterfloods can or should be prorated is to the fore again in several states that have just about reached the limit in curtailing everything else.

There are two aspects to this problem: engineering and economic; and neither one is all black or all white. Much more study is required before there can be satisfactory answers.

MOST OPERATORS are convinced that any interruption in the producing rate will cause permanent damage to a waterflood and reduce ultimate recovery. An impressive body of engineering data supports this view. But equally impressive engineering studies can be presented to the contrary.

On the basis of present knowledge it is probably a safe generalization that at least in certain types of reservoirs and flood patterns a curtailment incurs a grave risk of permanent damage.

The economic aspect is that most flood projects are engineered and financed to operate on a predicted production curve, so any curtailment causes financial loss. But most projects could be engineered initially to operate at a slow recovery rate.

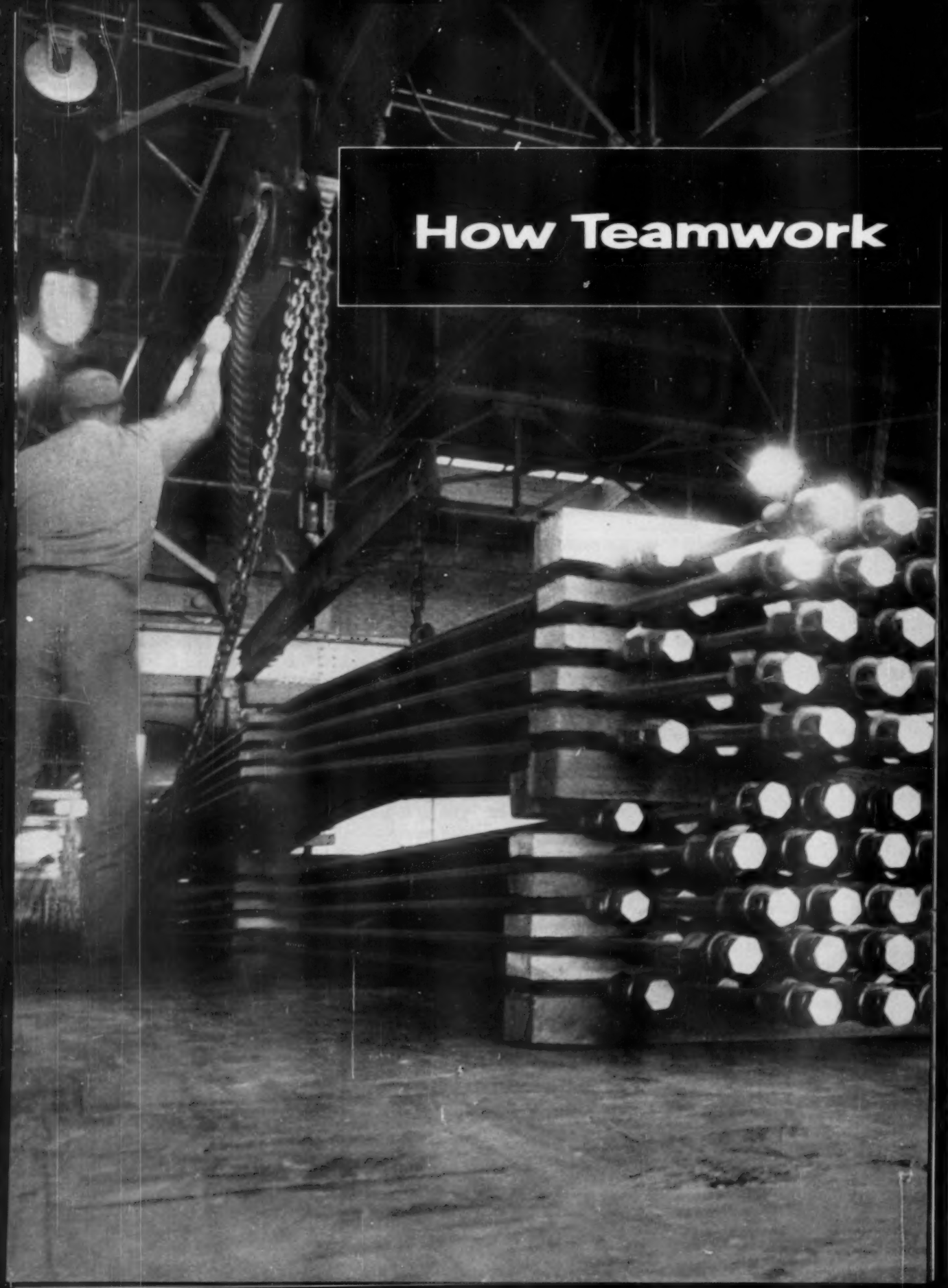
This brings the problem down to conservation policies. The basic objective of conservation is to increase ultimate recovery of crude. If, in the name of conservation, waterfloods are prorated to the point of actually reducing ultimate recovery it would seem that conservation is defeating its own purpose.

Proration is a tool of conservation whereby first call on the market is given to waterfloods and wells that could not compete economically with unprorated flush production. This is to encourage secondary recovery and prevent premature abandonment of recoverable oil. If, to prevent oversupply, proration has to be used against the very type of production it was designed to protect, something is wrong.

CAN IT BE that so large a proportion of the United States' oil comes from marginal wells and secondary-recovery projects that the conservation program cannot be achieved by prorating the remainder? If so, this is a potent factor in formulating an imports policy.

In any event, state conservation bodies should reexamine their policies on waterfloods. Perhaps flood operators should be warned that they are going to have to be prorated, permanent damage or no. Perhaps new projects must be engineered for the longest possible payout, rather than the shortest. Perhaps operators of flush and primary production should be made to understand that they, and not waterfloods, must bear the entire brunt of market-demand proration.

These are difficult decisions. But, in the long run, all concerned will benefit from a definite policy.



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The OIL AND GAS JOURNAL

March 31, 1958

What 8 Days Will Mean to Texas

- **State revenue** is skidding. In April it may run $4,000,000 under estimates, pose a deficit of perhaps $30,000,000 by June 30.
- **Oil unemployment** is climbing. In February it was up 17% from year ago. March and April cutbacks will jump it higher.
- **Bank loans** are being sought by more and more producers, and some can't qualify.
- **Contractors, truckers, suppliers** are hit, along with oil producers. Gas output is down, further pinching oil men, squeezing gas lines.
- **Producer income** is off $1,630,000 in just 2 months, will slip further in April.

Texas' Plummeting Allowable

	Producing days	Allowable, bbl. per cal. day
1957		
March	18	3,821,426
April	16	3,564,665
May	16	3,474,834
June	15	3,434,618
July	13	3,027,706
August	13	3,067,883
September	13	3,127,506
October	12	2,964,062
November	12	2,998,927
December	12	2,987,415
1958		
January	12	2,985,350
February	11	3,057,936
March	9	2,517,249
April	8	2,444,571
TOTAL DROP	10	1,376,855

Robert J. Enright
Dallas District Editor

TEXAS OIL MEN already see some benefits coming from the lean diet they have set for themselves in April.

On the brighter side trends are developing for:

. . . **Stocks to slide** down sharply in April to safer levels. This also should help pull down heavy national storage.

. . . **New connections** for distress crude which has been without a market.

. . . **Buyers to reenter the spot market** in many instances to get crude needed for refinery operations.

. . . **Firming up** the weakened crude-price structure.

A new twist . . . Clear indications that the slashed allowables are bearing fruit came at the Texas Railroad Commission allowable hearing.

Nearly all oil firms testified they would have to draw down stocks some if a 9-day pattern were kept for April. On 8 days as set by the commission, the downward pull will be more pronounced.

Positions of crude buyers vary.

Humble Oil & Refining Co. reports it can dip into its storage all through April to meet demand for oil and still have higher than adequate stocks at the end of the month. Humble, however, has oil coming out its ears. No other big buyer is so overloaded.

On the other end of the stick is Atlantic Refining Co. Atlantic says it needs 12 days production in April from its connections to meet needs. It has no excess crude or products storage to fall back on. It bought 1,000,000 bbl. of spot crude in March. The only way it can meet its need is to go much heavier to spot purchases in April.

Other major crude buyers fit in between Humble and Atlantic. Most will likely have to buy oil from wells other than those whose output they normally handle.

Some distress oil, perhaps quite a batch, will be bought and some unconnected wells will be hooked up—how much and how many is as yet uncertain.

Some oil without a market, as a matter of fact, was snapped up within minutes after the March 20 allowable hearing. Atlantic quickly made arrangements to take Eastland Drilling Co.'s shut-in production in Harper field of Ector County, West Texas.

Eastland had 12 wells with an allowable of about 760 bbl. daily shut in for lack of a market. This was oil penalized earlier in the year by a sharp 50-cent per barrel price cut by a coastal refiner. Eastland refused to take such a cut and had been without a market since. Atlantic reportedly will pay Eastland $3 a barrel.

Such hurried action on the part of the buyers could bode better times for Texas producers in coming months.

Who will get hurt . . . The entire Texas economy, however, will pay a heavy price in the attempt to cure the oil industry's ills.

The 8-day production figure means an initial Texas allowable for the

WEST TEXAS will feel the economic pinch of an 8-day allowable next month. Rig activity already is down 34% below last year and expected to drop even lower.

month of only 2,444,571 bbl. daily. This is a drop of 1,376,855 bbl. daily since the end of the Suez crisis in March 1957 and a plunge of 545,000 bbl. daily since February 1958.

It is the lowest calendar-day allowable in almost 8 years—since June 1950 when the Texas Railroad Commission fixed flow at 2,368,073 bbl. daily.

The April 1958 allowable, however, is far below that of June 1950 on a per-well basis. This is because there are 63,500 more wells now than there were then. Commission figures show 182,500 wells in the state. In June 1950 there were only about 119,000.

What does this production slowdown mean to Texas? Since the state economy is based heavily on petroleum, it means rough sledding.

Sharp cuts in March income of producers (from 9-day allowable) already are being felt quickly by drilling contractors and equipment and service suppliers in the form of further reduced business. Oil employment is falling off. Shrinking royalty checks are heavily affecting retail sales in oil communities. These effects should snowball in April.

State, local, and school taxing bodies are becoming more and more apprehensive as oil-tax estimates made last year begin to look unrealistically high.

Over-all, things look pretty bleak.

The Producer Situation

The income of Texas producers from oil sales now is running an estimated $3,600,000 daily under March 1957 and has dropped roughly $1,630,000 daily since the last of February.

Banks report a mounting number of requests for refinancing oil loans—some of which they can't grant because of excessive risk. Many smaller independents are borrowing on next month's production to pay expenses.

Oil doldrums are evident in all parts of the state but probably the worst in West Central Texas, the Panhandle, parts of North and West Texas.

Despite the low allowables there still is some purchaser proration.

One such area is Sharon Ridge of Scurry and Mitchell counties. C. T. McLaughlin, president of the Sharon Ridge Producers and Royalty Owners Association, says the membership is able to market only half the allowable of its 1,636 wells. The wells were producing 7,500 bbl. daily in March of which 2,300 bbl. daily was trucked.

To add to their troubles, the Sharon Ridge producers took a 30-cent price cut recently—from $2.80 to $2.50 a barrel for their asphaltic-type crude.

Other woes . . . Similar situations crop up all over the state.

M. G. Hansbro, independent, reports purchasers took only 3 days production from his East Texas leases in March despite the 9-day allowable. He advocates a complete shutdown of production in the state for 60 days until excess stocks be consumed.

In North Texas, Steve Gose, Wichita Falls independent, says he is able to sell only 300 bbl. monthly of a 1,600-bbl. monthly allowable from Tannehill production in Knox and Throckmorton counties. Other producers in the area are in even worse shape, he contends.

In Northeast Texas' Red River County, I. & L. Development Co. has had no market for its oil from I&L field for 4 months.

The Panhandle area, plagued with purchaser proration for months, likely will get more of the same. J. H. Dunn, president of Shamrock Oil & Gas Corp., one of the larger oil buyers in the area, says his company is faced with drastic purchase cutting.

Even under the March allowable, Shamrock will have 600,000 bbl. of excess oil "and no place to go with it." Shamrock has scheduled a 30-day shutdown of its refinery for turnaround in April. It must make further drastic cuts in purchases next month.

Casing-head cut, too . . . Actually oil producers take a double lick from such low allowables—their casing-head gas sales fall off proportionately with oil.

In some areas, loss of the income from casing-head is critical. In Spraberry Trend Area field and others like it, many independents are able to keep producing their oil wells solely because they are able to sell casinghead. Income from substantial gas production to supplement that from the daily dab of oil is keeping many wells from being plugged. If oil income were the only factor, many such wells would already have been abandoned.

Thus it was a strange sight to see Texas independents at the April allowable hearing abandon their traditional struggle for higher allowables and actually seek the cut to 8 days.

Their thinking was summed up neatly by two men—Jake L. Hamon, Dallas operator and former board chairman of the American Petroleum Institute, and M. G. Langhorn of Hunt Oil Co., Dallas.

Hamon spoke for nearly 100 producers who met in Dallas prior to the hearing and backed the 8-day pattern.

He said "everyone agrees that stocks are far too high" and pointed out that "April is traditionally a low-demand

month due to refinery turnarounds. All anyone needs to do is to look at present levels of auto and steel production, unemployment, and business generally to see that at best we can't look for demand to equal last year.

"Another 9-day allowable in April, with its resulting increase in production even though slight, would make it appear in Washington that we don't need help—just when they're about to act (on imports cut)."

The only reasonable course open to Texas, even though it hurts badly, Hamon said, "is to meet the problem headon."

Langhorn argued that to hike allowables now "is to borrow trouble." The facts supporting a cut are plentiful, he said, while there are none indicating an increase in oil output.

Distress areas still have oil without a market. This, Langhorn said, shows either that allowables haven't been cut enough or that purchaser nominations have been inflated. "I think both are true."

Many Texas producers think purchaser nominations haven't been realistic. The Texas allowable has been cut several times in the past year to levels sought by purchasers—but stocks rather than dwindling have kept climbing. The only solution, many think, is to set an allowable which would definitely give purchasers less oil than they seek.

Producers think they have accomplished this for April.

The spectre of further crude-price cuts was not mentioned in the Austin hearing. Fringe snipping continued on prices during March in various areas of Texas. And producers wanted to stop this trend once and for all before the general price structure cracked.

Effects Backing Up

Deep cuts in producer income in Texas are showing up in decreasing exploration and fewer well completions.

And this has backed up trouble on drilling contractors, geophysical firms, and equipment, supply, and service companies.

Last year wasn't a great year in Texas compared to preceding ones, but it looks good stacked against 1958 so far.

To March 15, 1958, operators had completed only 3,901 wells (oil, gas, and dry) in Texas against 4,609 for the same period in 1957. They drilled only 831 wildcats this year against 1,292 last year to the same date.

Only 699 rigs operated in Texas for the week of March 18 against 1,052 for week of March 18, 1957—when the industry was wondering why drilling activity wasn't picking up.

West Central Texas again furnishes a good example of present conditions.

To March 14 only 590 applications were filed to drill in this area, against 794 in the same period last year. The number of rigs working in the West Central area has fallen from 170 a year ago to 89.

In the Sharon Ridge portion of the area, there is just one rig operating where for several years there have been around 25.

Frank Conselman, well-known Abilene consulting geologist, reports that the past 4 years have witnessed a drop in geophysical crews in West Central Texas from 44 to 11. Membership in the Abilene Geological Society, he says, has fallen from 345 a year ago to only 295 now.

Grady Roberts, Abilene oil equipment supplier, has cut his payroll from 13 a year ago to 9 now and contemplates a further cut to only 6 employes within the month. Producers, he says, are taking longer to pay and "accounts have gone bad."

Paul Graham, trucking contractor, says that 6 months ago he was operating 20 trucks and guaranteeing employes 50 working hours a week. Now, he says, "I'm down to 13 trucks. And there have been only 2 weeks since Christmas when my employes worked as much as 50 hours."

Scurry County, home of huge Kelly-Snyder field and one of Texas' big producing counties, reported 772 persons on relief in mid-March, compared with 300 in March 1957. The number is expected to go up in April.

Fred Husbands, executive vice president of the West Texas Chamber of Commerce, says monthly average employment in January-February this year in a 19-county West Texas producing area is down 17% from the monthly average in 1957. Employment, he says, dropped from 36,131 last year to 29,958 in January-February this year. The number of rigs active in the area is down 34%, Husbands declares.

He predicts that figures for March and April will show further sharp drops in employment.

Royalty payments in West Texas in 1957, Husbands estimates, totaled about $258,000,000. "If Texas averages a 9-day producing pattern the rest of the year, West Texas royalty owners will lose about $103,000,000."

Revenue Picture Bleak

Last September, Texas Comptroller Robert Calvert estimated Texas production from July 1, 1957, to June 30, 1958, would run just under the same period a year earlier.

He based his revenue estimates from Texas' crude-oil production tax on this figure. Appropriations during a special legislative session last fall ate up what then appeared would be a small surplus in revenues.

The picture has since changed drastically. A spokesman in Calvert's office told the Journal last week that revenues to the first of March already were $6,000,000 under expectations. A 9-day allowable continued to June 30, he said, would put the state another $20,000,000 in the hole.

Texas, thus, is reaping the harvest it sowed in prevous years by basing its economy too heavily on oil.

The petroleum industry in fiscal 1956-1957 paid a record $200,735,000 into the state treasury. According to the Texas Mid-Continent Oil and Gas Association, the industry paid 69% of all business and property taxes collected by the state and 30.7% of the total tax bill.

Whereas Texas collects 29.7% of state revenues from oil and gas severance taxes, all other states combined collect only 1.4% from this source.

The 4.6% crude production tax yielded Texas $136,296,000 for fiscal 1956-57.

In addition to state taxes, Texas oil and gas producers help support units of local government such as independent school districts and water and levee districts.

Taxes on oil and gas operations pay roughly one-third of the property taxes collected by the state's 254 counties.

A Texas Mid-Continent study recently of 386 independent school districts in the state which take in oil and gas properties shows the latter paid more than 90% of the local taxes in 45 districts; 80% in 89 districts; 70% in 123; 60% in 156; and more than 50% in 188.

Figures are also available to show that oil and gas taxes pay 45% of the state cost of public education, 59% of state old-age pensions, and 36% of higher education.

Last fiscal year, industry operations on University of Texas and public-school system lands put $36,000,000 in lease rentals, bonuses, and royalty in the Permanent School Fund and $37,000,000 into the Permanent University Fund. This year's industry contribution to these funds will be far below these figures—due to lack of interest in leasing and low production.

Along with the direct taxes paid by the industry, the state gleaned another $757,000,000 from consumers via its gasoline tax.

From this it's easy to see why Texas, generally, is suffering along with its producers and their oil relatives.

How President's Order Cuts Imports

Eisenhower follows a cabinet committee recommendation which trims current imports 8% to a new total of 713,000 bbl. daily. The program will still be voluntary. Those who don't comply face the loss of government business.

PRESIDENT EISENHOWER in a sweeping executive order has ordered imports of foreign oil cut starting April 1.

The President cut quotas for present importers, gave quotas to new importers, and put new teeth into his voluntary control program.

The chief executive, adopting recommendations made by the cabinet fuels committee, chose to stay with the voluntary approach but threatened companies refusing to comply with loss of government business.

His order cut imports to 713,000 bbl. daily during the next 6 months in a manner predicted weeks ago by the Oil and Gas Journal (OGJ, March 17, p. 77 and March 24, p. 96).

The new quotas are designed to adjust the voluntary program adopted last July 29 to present conditions, it was explained by Commerce Sec. Sinclair Weeks, chairman of the committee.

Here is what the new imports plan looks like:

... **The import curb** will continue to be on a voluntary basis.

... **The import level** will be geared to the same (12%) relation to domestic production as the original program.

... **The current level** of imports will be cut approximately 8%.

... **Lower quotas** will be allotted to most present importers to make room for newcomers.

... **No changes** will be made in the voluntary program for the West Coast which went into effect in January.

The new over-all allocation of 713,000 bbl. will have little immediate effect on actual imports, which last month were 670,300 bbl. daily.

Newcomers considered . . . Given a continuation of imports at about the February level, there will be some 43,000 bbl. a day available for newcomers.

New importers will not be an immediate problem. Although more than a score of applications were heard last month by Capt. M. V. Carson, Jr., program administrator, only one calls for imports before June.

The new allocation table provides for 14 of these applicants and also restores Hess, Inc. to the list. It was explained that Hess has been a longtime importer but had not felt it was covered by the voluntary program. Hess was granted an allocation of 11,500 bbl. daily.

The decision to take no action on the West Coast program was prompted by the fact that actual imports this year have been far under the allowable. It is reported, in fact, that only one refiner outside the group of major companies that were "established" importers has taken advantage of his quota.

Preliminary reports indicate actual imports into District 5 in February averaged only 143,000 bbl. daily against recommended level of 220,000 bbl. daily.

The new import program wipes out the original plan to limit imports on a 12-month basis. The new level will prevail for next 6 months, at least. The cabinet committee, however, may take another look at the situation 3 or 4 months hence, if economic conditions change further, either for better or worse.

Administration's views . . . The writing of the new program was disclosed by Weeks as he testified as the last witness in a 5-week hearing on extension of the Reciprocal Trade Act.

Challenging demands for a quota provision in the new bill, Weeks declared the voluntary program "was far more effective than had been anticipated."

Weeks noted that only "two notable and one minor" violations of the quotas by individual importers had been recorded.

In the new program, Weeks said, "we want to gear it to the present conditions on the same percentage basis, then provide for newcomers by having other importers move over, and try to work it out so the voluntary program will be effective."

If the voluntary plan doesn't work, he added, "we always have the mandatory program to go to and I am quite sure we would go to it."

Some aren't satisfied . . . A skeptical House ways and means committee, however, was not satisfied with Weeks' assurance that the new plan would answer the complaints of domestic producers against foreign oil.

Instead of ending the hearings on the trade bill as planned, it asked Weeks to come back after the new program was announced and give a more detailed defense of it.

President's order . . . Importers who haven't in the past complied with the voluntary program are now given 30 days by the President to bring their imports into line.

At the same time, the executive order warns all importers doing business with the Government that they will lose that privilege if they do not adhere to their quotas.

The executive order putting teeth into the program calls on all government buying officers to buy products made from foreign oil only if domestic products are unavailable or offered at an "unreasonable" price and then only if they are a "complying petroleum company."

The President ordered that "every contract entered into by any executive department or agency for purchase in the U.S. of imported crude or petroleum products refined in the U.S. and derived in whole or in part from imported crude shall contain the following provision: 'Contractor agrees that during the contract period he will comply in all respects with the voluntary oil program.'"

The order authorizes the cabinet fuels committee to issue certificates of compliance which may be accepted by the government buying agencies. However, lacking such a certificate, a representation of compliance made by the supplier may be considered sufficient.

The committee report . . . The cabinet committee in its report to the President pointed out that its initial analysis last year showed that imports ratio of 12% to production east of the Rocky Mountains would not discourage exploration and production to an extent adversely affecting national security.

"After reviewing developments since the date of the original report, the committee has concluded this ratio should continue to be maintained in order to achieve the objectives stated in our original report," the committee

Here's What Companies Can Import in the Next 6 Months

(Allocations, thousands of barrels daily)

Company—	Present	Effective date	April 1	June 1	July 1	August 1	Sept. 1
Established Importers							
Atlantic Refining Co.	58.9	.....	53.5	53.1	51.7	50.9	50.2
Gulf Oil Corp.	111.6	.....	101.3	100.6	98.0	96.3	95.1
Sinclair Refining Co.	62.2	.....	56.5	56.1	54.6	53.7	53.0
Socony Mobil Oil Co., Inc.	67.1	.....	60.9	60.5	59.0	57.9	57.2
Standard of California	66.8	.....	60.7	60.2	58.7	57.7	56.9
Standard Oil (N. J.)	72.0	.....	65.4	64.9	63.2	62.1	61.4
Texas Co.	54.5	.....	49.5	49.1	47.9	47.0	46.4
Subtotal	**493.1**	.....	**447.8**	**444.5**	**433.1**	**425.6**	**420.2**
New Importers							
Aurora Gasoline Co.	.....	9-1-58	....	....	....	....	3.5
Bay Refining Corp.	3.2	.....	2.9	2.9	2.8	2.7	2.7
Cities Service Co.	32.6	.....	29.6	29.4	28.7	28.1	27.8
Clark Oil & Refining Co.	.....	4-1-58	2.0	2.0	2.0	2.0	2.0
Continental Oil Co.	.....	8-6-58	....	....	....	5.0	5.0
Crown Central Petroleum	5.0	.....	4.5	4.5	4.4	4.3	4.3
Denaho Refining Co.	.....	7-24-58	....	....	....	0.5	0.5
Delta Refining Co.	.....	8-3-58	....	....	....	3.0	3.0
Dow Chemical Co.	0.3	.....	0.3	0.3	0.3	0.3	0.3
Eastern States Petroleum	18.3	.....	16.6	16.5	16.1	15.8	15.6
Gabriel Oil Co.	7.5	.....	6.8	6.8	6.6	6.5	6.4
Great Northern Oil Co.	33.0	.....	30.0	29.8	29.0	28.5	28.1
Hess, Inc.	11.5	.....	10.4	10.4	10.1	10.0	9.8
Ingram Oil & Refining Co.	.....	7-15-58	....	....	3.5	3.5	3.5
International Refining Co.	12.3	.....	11.2	11.1	10.8	10.6	10.5
Lakehead Pipe Line Co.	0.3	.....	0.3	0.3	0.3	0.3	0.3
Lake Superior Refining	5.0	.....	4.5	4.5	4.4	4.3	4.3
Northwestern Oil & Refg.	13.5	.....	12.3	12.2	11.9	11.7	11.5
Ohio Oil Co.	.....	8-12-58	....	....	....	3.5	3.5
Phillips Petroleum Co.	12.0	.....	10.9	10.8	10.6	10.4	10.2
Pure Oil Co.	.....	6-10-58	....	5.0	5.0	5.0	5.0
Republic Oil & Refining	.....	7-1-58	....	....	4.0	4.0	4.0
Shell Oil Co.	7.5	.....	6.8	6.8	6.6	6.5	6.4
Standard Oil Co. (Ind.)	29.8	.....	27.1	26.9	26.2	25.7	25.4
Standard Oil Co. (Ohio)	8.2	.....	7.4	7.4	7.2	7.1	7.0
Sun Oil Co.	50.4	.....	45.8	45.4	44.3	43.5	43.0
Sunray Mid-Continent Oil Co.	.....	9-1-58	....	....	....	....	5.0
Southwestern Oil & Refg.	2.9	.....	2.6	2.6	2.6	2.5	2.5
TGT & Bay Petroleum	.....	6-16-58	....	....	3.5	3.5	3.5
Texas Asphalt & Refining	2.3	.....	2.1	2.1	2.0	2.0	2.0
Texas City Oil & Refg.	.....	7-1-58	....	....	4.0	4.0	4.0
Tidewater Oil Co.	34.2	.....	31.1	30.8	30.0	29.5	29.2
United Refining Corp.	.....	7-1-58	....	....	3.0	3.0	3.0
Subtotals	**289.8**	.....	**265.2**	**268.5**	**279.9**	**287.3**	**292.8**
Totals	**782.9**	.....	**713.0**	**713.0**	**713.0**	**712.9**	**713.0**

said in its report to the President.

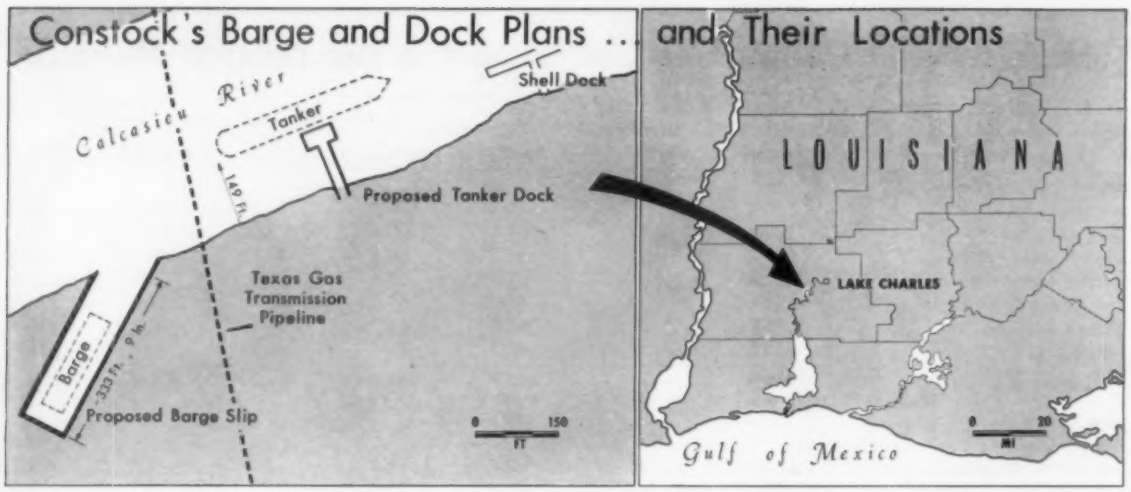
The committee also included in its report a definition of an importer. Lack of such a definition has hampered Carson in acting on applications from newcomers.

An importer is now defined as anyone who (1) was engaged in importation of crude oil into U.S. during the last half of 1957, (2) had an approved allocation under the voluntary oil imports program on January 1, 1958, or (3) had existing refining capacity within the U.S.

The committee also reported that Mobilization Director Gordon Gray has found that imports of distilled products including residuals are not a threat to the voluntary program.

Gray, however, called attention to reports that some importers plan later to bring in unfinished distilled products. It is estimated that such imports during first half of this year will be about 12,900 bbl. daily over those brought in at the end of 1957 but still will approximate the level imported in 1954.

It was a lack of teeth in the program that is influencing many members of Congress to fight for the inclusion of a quota provision in the trade act.



Louisiana Gas May Move to Europe

DETAILED PLANS for proposed liquid-methane loading facilities in South Louisiana have been filed with U. S. Army Engineers by Constock Liquid Methane Corp.

Similar plans, approved earlier by the Calcasieu Parish police jury, led to widespread speculation that Gulf Coast gas fields may be the source of methane for initial shipments to Europe in liquid form (OGJ, Mar. 10, p. 106).

The proposed facilities would include both a barge slip and tanker dock on the bank of the Calcasieu River about 8 miles southwest of Lake Charles, La. Maps filed with the Army Engineers indicate the Constock installations would straddle a Texas Gas Transmission Corp. pipeline which crosses the river at that point (see map).

Constock is owned jointly by Continental Oil Co. and Chicago Stockyards Co. Constock officials have announced plans for shipment of liquefied methane to England. A tanker to be used in transocean shipping is now being converted at a Mobile, Ala., shipyard. The company also has been experimenting with an insulated barge for possible use on inland waterways.

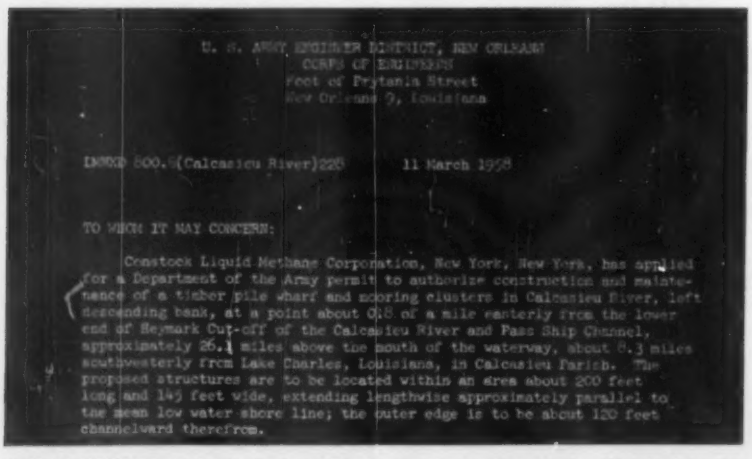
Source of gas . . . Constock officials have been close-mouthed about the source of gas and other details regarding company plans.

However, a company newspaper distributed among Continental employs recently announced that plans for the venture were being laid in such widely scattered points as Japan, Mexico, Venezuela, Great Britain, and Houston, in addition to the Mobile-Lake Charles coastal area.

Mexico and Venezuela presumably are being considered as possible sources of natural gas. The announcement would indicate that Japan, as well as England, may provide a market for the liquid gas.

The publication quoted an anonymous Continental executive as saying, "Constock could at some time be even larger than Conoco."

Constock has not disclosed when construction of the Louisiana installation is planned.



U. S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
Foot of Prytania Street
New Orleans 9, Louisiana

LMNOD 800.4(Calcasieu River)226 11 March 1958

TO WHOM IT MAY CONCERN:

Constock Liquid Methane Corporation, New York, New York, has applied for a Department of the Army permit to authorize construction and maintenance of a timber pile wharf and mooring clusters in Calcasieu River, left descending bank, at a point about 0.8 of a mile easterly from the lower end of Heymark Cut-off of the Calcasieu River and Pass Ship Channel, approximately 26.1 miles above the mouth of the waterway, about 8.3 miles southwesterly from Lake Charles, Louisiana, in Calcasieu Parish. The proposed structures are to be located within an area about 200 feet long and 145 feet wide, extending lengthwise approximately parallel to the mean low water shore line; the outer edge is to be about 120 feet channelward therefrom.

THIS DOCUMENT of the U. S. Army Engineers shows Constock's official plans for building a dock on the Calcasieu River.

Los Angeles Areas Opened

DRILLING in residential areas of Los Angeles received a boost last week when the City Council approved three drilling permits in widely-scattered areas of the city.

The permits give oil companies the right to explore for oil where the majority of the property owners in the area have signed community leases.

These are the areas:

. . . A portion of the old Los Angeles field on the northwest border of downtown Los Angeles.

. . . An area that takes in the Los Angeles Country Club in West Los Angeles. This acreage adjoins the 20th Century Fox movie lot where Universal Consolidated Oil Co. has had a successful drilling operation going for several years.

. . . An area in West Los Angeles west of the 20th Century lot.

The council turned down King Oil Co.'s request for a drilling permit covering 260 acres in Hollywood.

Single Contract Sought

. . . for all Socony refineries by OCAW. Union expects all contracts in oil industry to be opened by late spring.

THE OIL, Chemical and Atomic Workers International Union is attempting to end plant-by-plant collective bargaining and obtain "top level" negotiations with Socony-Mobil Oil Co.

"We seek an opportunity to bargain effectively with company officials who have authority to make decisions on the various cost and benefit items which are so important to us," representatives of Socony OCAW locals said in a resolution.

"If this cannot be achieved through local bargaining, then we strive for top level central bargaining."

Socony operates eight refineries with total daily capacity of nearly 300,000 bbl. Plants are located at Buffalo and Brooklyn; Paulsboro, N. J.; Trenton, Mich.; East Chicago, Ind.; East St. Louis, Ill.; Casper, Wyo.; and Augusta, Kan. Socony also operates a 500-bbl. daily asphalt plant at Riverside, R. I.

Socony OCAW group contends that plant-by-plant bargaining "has usually demonstrated the complete lack of authority on the part of the local management to do more than listen and give lip service to the principles of collective bargaining."

Socony workers also say that benefit plan changes and other cost items are always worked out at the top level in the company. The decisions then are forwarded to plant managers.

OCAW is being joined in the move by three independent unions representing other Socony employes. They are the Independent Oil Workers of Paulsboro, the New England Petroleum Labor Organization, and the Sovac Petroleum Union of South Jersey.

OCAW now has only one nationwide contract in the oil industry. It is with Sinclair Oil Corp. A 2-year agreement signed last year by Sinclair and OCAW runs until June 15, 1959. It will be open this year only for wage adjustments and for conferences dealing with any contract problems which might arise.

New objectives . . . Meanwhile, the OCAW council representing members employed by Cities Service Co. has adopted an 11-point program it will push in addition to the union's mandatory 1958 bargaining goals.

The additional objectives include full payment by the company of the cost of fringe benefits and no contracting out of work as long as the company has the equipment or while there are laid off employes capable of doing the work. Other goals are premium pay for Saturday and Sunday work, one additional day of vacation for each year of service after 10 years, three additional holidays, double time for overtime, union shop where permitted by law, improved sick and disability insurance, improved thrift plan, a discount on all products handled by the company, and improved funeral leave.

The mandatory program, adopted in February by OCAW's bargaining policy committee, provides for 4 months' advance notice of layoffs exceeding 5% of the work force in any bargaining unit, severance pay for laid off employes, and an annual wage raise equaling the increase in the cost of living plus 3½% a year for increased productivity.

T. M. McCormick, OCAW secretary-treasurer, estimates that more than 5% of the union's 210,000 members have been laid off since January 1. There is no indication how many of the union's 105,000 oil-industry workers have been let out.

The severance pay plan which OCAW is attempting to negotiate from the companies calls for 2 weeks' pay for each year of company service, plus an extra 10% for each year of age over 40 up to a maximum of triple the basic 2 weeks a year. Thus, an employe laid off after 30 years of work at age 59 would be entitled to 174 weeks of regular wages.

Oklahoma Lifts Restriction on Waterfloods

THE OKLAHOMA Corporation Commission heeded the pleas of waterflood producers last week by eliminating proration of floods.

To keep total production from shooting skyward, the commission ordered further cutbacks on allocated pools and reduced the top allowable for unallocated wells from 18 bbl. per day to 15.

The production estimate for April was placed at 510,000 bbl. per day, about 6,000 bbl. over March but still below February's output of 552,000 bbl. per day.

At its monthly allowable hearing last week, the commission heard complaints from many operators of waterflood projects that the 11% cutback across the board for all producers in March would cause permanent damage to their floods if allowed to continue for more than a month.

The commission already had granted a large number of exceptions to the order for waterfloods which are currently building up pressure so as not to disturb the efficiency of flood operation. Operators of many other floods also continued to produce at maximum levels but kept within the allowable order by storing the overproduction (OGJ, March 24, p. 94).

Under the new order for April, the commission ruled that 10% of all waterflood production will be considered as overage to be made up at a later date.

The reason . . . In explaining the commission's decision to cut short the 1-month experiment, first of its kind for the industry, Chairman Ray C. Jones said waterflood operators needed relief "so they won't have to take such a severe cut all of a sudden."

Jones said the commission's new field rules, soon to be announced, will make provision for some type of cutback in waterflood production "over a period of several months."

"It's hard to reduce production in floods unless you give them some time to get their operations in shape," he said.

At last week's hearing, one witness for a company with waterflood projects said the March cutback was "the wrong approach" and "illegal."

Another said: "We thought we could live with the order in March, and we have lived with it. But if the commission continues this order in April, we will be compelled to come here and ask for relief for all our waterfloods."

The allowable order for April provides that wells in allocated pools can produce their regular allowable, less 20% of actual February pipeline runs. This compares with March's 11% cutback from January runs.

The total estimated production of 510,000 bbl. per day for April is just 2,500 bbl. above purchaser nominations for the month.

Here's a 20-Company Look at Ideal Inventories for '58—and

(Millions of barrels)

	Crude		Gasoline		Kerosine		Distillate	
	April 1	November 1	April 1	November 1	April 1	November 1	April 1	November 1
Atlantic Refining	270	270	190	150	18	38	65	160
Standard of California	265	270	190	155	20	35	65	155
Cities Service	250	260	190	160	17	34	65	155
Continental	255-260	260-265	195-200	165-170	17-18	33-34	65-70	165-170
Eastern States	265	265	175	135	22	45	75	130
Gulf	245-250	245-250	160	125	18	35	55	150
Humble	260	265	190	155	17	34	70	165
Magnolia	255-260	260-265	185	150	16	35	64	160
Phillips	260-265	260-265	180-190	150-160	16-17	35-36	65-70	155-165
Shell	260	265	190	155	18	38	67	162
Sinclair	265-270	270-275	190-194	156-160	18	36	68-70	160-164
Socony Mobil	255-265	260-270	185-195	150-155	16-19	35-38	64-68	165-175
Standard of Ohio	265	275	180	150	20	38	65	165
Indiana Standard	260	260	195	160	20	35	65	165
Jersey Standard	260-270	265-275	195-200	165-170	16	33	65-70	165-170
Sun	260	265	185	155	18	35	65	150
Texaco	265	265	185-190	145-150	16-17	35-36	64-65	147-152
Tidewater	250-260	255-265	185-195	150-160	16-18	32-36	65-70	155-165
Crown Central	250	260	185	150	18	30	60	150
Pure	264	266	192	159	16	30.5	72.6	157.6
Composite	**260.33**	**264.43**	**187.33**	**153.10**	**17.85**	**35.33**	**66.12**	**157.93**

Demand Better in '58—But Nothing To

DOMESTIC DEMAND for petroleum will increase 1.14% this year, according to the consensus of economists of 20 major oil companies.

This figure is a composite of individual company demand estimates presented to the Texas Railroad Commission by executives of these firms during Texas' allowable hearing for April.

It will be used by the commission, together with data on desired levels of crude and products stocks and planned imports, as an aide in regulating Texas oil output the rest of the year.

The meager boost predicted for domestic demand in 1958 is in sharp contrast to the 4.6% increase expected but not achieved in 1957 by the same firms and the 4% or so annual gain the industry had come to regard as normal since the war.

Guessing game . . . Company forecasts this year fluctuated widely.

And the unusually large spread from highest to lowest underscores the feeling of uncertainty as to what is in store for demand the rest of the year.

Seven companies, among them Sinclair, Indiana Standard, Sun, Pure, Humble, Continental, and California Standard look for no increase at all in domestic demand.

A few, however, are quite optimistic. Tops in this class is Shell with a predicted 3.6% hike. Others on the high side are: Standard of Ohio, 3%; Texaco, 2 to 3%; Tidewater and Cities Service, 2%; Atlantic, 1 to 3%; Magnolia, 1.5 to 2; Phillips, 1.5; and Socony Mobil, 1 to 2.

The world's biggest oil firm, Jersey Standard, nearly hit the composite figure with its 1% expected gain.

Stocks too high . . . Though disagreeing on 1958 demand, the 20 companies were virtually unanimous in their opinions on the present levels of crude and product stocks.

Their verdict: Too high by about 60,000,000 to 80,000,000 bbl.

Most, however, felt that lowered allowables and reduced refinery runs are now beginning to show up in lower stocks figures. They predicted the slide in stocks would become more pronounced this spring.

The general feeling appeared to be that the present crushing inventories can be cut to safer levels within 2 or 3 months if:

. . . Crude allowables are held down.

. . . Imports are cut back some.

. . . Refinery runs remain low.

Morgan J. Davis, Humble's president, fixed the total stocks surplus at about 67,000,000 bbl. now despite lowered allowables and runs.

A number of factors, he said, have helped the industry get itself into this sloppy situation. He listed these as excessive imports of crude and products, the current business recession, and a faster rate of expansion than warranted by demand in the light of growing competition from natural gas and other fuels.

Again this year the commission asked opinions of the companies on ideal crude and product stocks levels for April 1 and November 1. The first date heralds the beginning of

at Domestic Demand

Residual April 1	Residual November 1	Demand increase 1958 over 1957 (%)
40	50	1 to 3
40	45	0
38	50	2
33-36	42-45	0
40	50	0-2
40	50	1
36	50	0
35	48	1.5-2
36-38	45-50	1.5
38	48	3.6
36-38	48-50	0
35-37	48-50	1-2
40	50	3
40	50	0
38-40	50-52	1
40	50	0
38-40	50-53	2-3
35-40	45-50	2
30	45	0
36.4	47.4	0
37.67	49.12	1.14

Brag About

the heavy gasoline consuming season. The second is about the time when gasoline demand has tapered off and the hard winter pull on the heavier products starts.

The outlook . . . The oil executives generally believe the ideal level of crude stocks on April 1 should be 260,330,000 bbl.

That's slightly under the 260,800,000 bbl. the same companies held desirable at the same time last year.

The ideas on crude-stock levels, however, ranged widely from company to company. The range went from Gulf's low opinion of 245,000,000 to 250,000,000 bbl. to the Atlantic's high of 270,000,000.

The 260,330,000-bbl. composite compares with actual crude stocks of 283,846,000 bbl. on March 15 as reported by the Bureau of Mines. Stocks at the same time last year totaled only 252,000,000 following a heavy drain due to the Suez crisis.

The composite ideal for November is 264,430,000 bbl.—also a bit under last year's.

Antitrust Suits Beaten

. . . in U.S. court. Judge says dividends paid by pipelines don't violate decree. Valuation practices are upheld.

A BELATED government effort to rewrite the 1941 pipeline consent decree collapsed in failure last week.

A series of rulings by Federal District Judge Richmond B. Keech knocked out three of four suits filed last October 11 by the Justice Department charging that major oil pipelines paid dividends to their shipper-owners in excess of the 7% allowed under the decree.

The fourth suit, against Texas Pipe Line Co., was settled by consent February 11. The company had been charged with figuring the dividend for The Texas Co., its shipper-owner, on a valuation basis which included leased property.

Under the consent order, Texas Pipe Line transferred to surplus some $100,000 which it had classified as earned and payable to the shipper-owner in the future.

Companies correct . . . In the other three cases, which went through a quick trial last week, Judge Keech ruled there was nothing in the 1941 decree to prevent the pipelines from adopting the accounting practices they used.

Even if there had not been, Keech said, the acceptance of those practices over a 16-year period tended to make them proper.

The key case in the group was that of Arapahoe Pipe Line Co., which the Government charged had violated the decree by figuring dividends on $26 million of property financed by third parties.

Justice Department counsel argued that the decree limited dividends to shipper-owner to 7% of valuation based on invested capital only.

The inclusion of loan capital created a "ludicrous" situation, the department contended.

Arapahoe attorneys told the court that the decree called for dividends based on valuation as determined by the Interstate Commerce Commission. The ICC, they said, allows the use of loan capital, and it would be "fantastic" not to use it.

The 1941 consent decree was accepted by the industry because "it had a gun at its head," the court was told. The threat of the Government to ask treble damages totaling $1 billion was too strong to be resisted.

The Government's suits were an effort to rewrite the agreement, Judge Keech said. The decree "is clear upon its face" and was given court approval in 1941 and again in 1942.

"I do not treat the proceedings before me as asking for abandonment of the decree in toto," he said. "Actually, if I were required to act upon such a request, I would not hold that the decree, as it has been interpreted by the parties over a period of 16 years, violates the Elkins Act."

The decree, Judge Keech continued, was a means by which the two sides "attempted to ride out a situation where issues had been joined but never determined."

"I have stated to you that I find no ambiguity in the terminology of the decree," he continued. "I think it is clear upon its face; but even if there had been ambiguities, I certainly would be constrained to hold that ambiguity had been resolved through the practice of the defendants, acquiesced in by the Government after full disclosure throughout the 16 years."

Other cases . . . Judge Keech later also dismissed suits against Service Pipe Line Co. and Tidal Pipe Line Co.

He held that Service had acted properly in including in its valuation additions and betterments as they were completed.

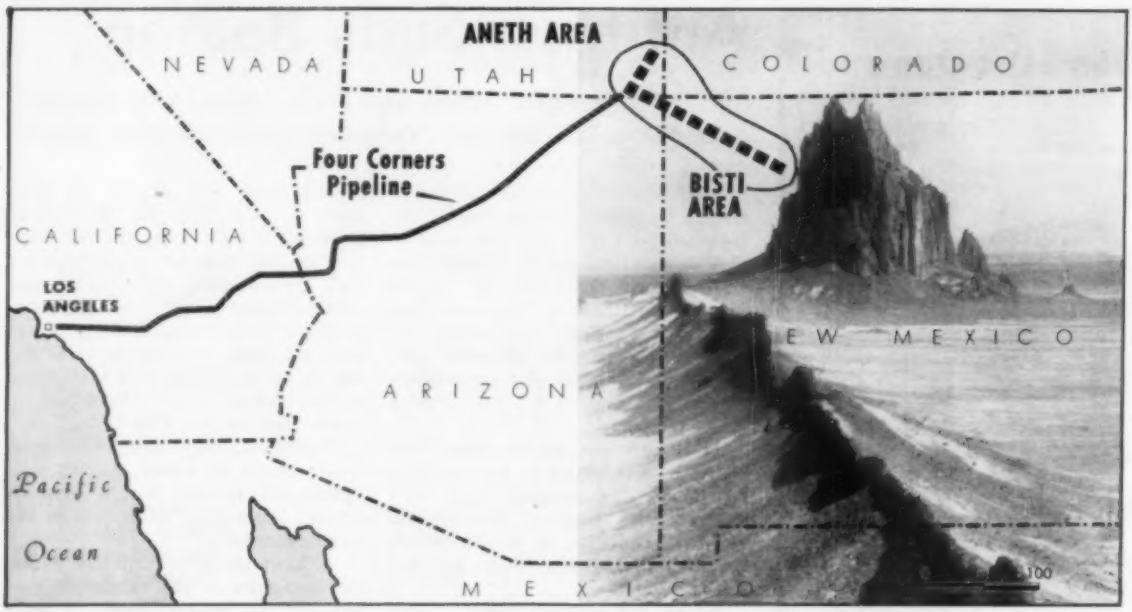
The court also ruled that since the ICC valuations permitted such action, there was no reason to disturb it.

In the Tidal case, the department charged the company violated the decree by basing valuation on the common-carrier property owned or used for common-carrier purposes instead of only on property owned and used.

But Judge Keech pointed out that the department had been long aware of this practice and had done nothing about it for 16 years.

When the cases were filed last October, Victor R. Hansen, assistant attorney general and antitrust chief, called the action "a significant step in the program of enforcement of the antitrust laws in connection with the oil industry."

There was no indication from Justice officials as to whether they would appeal Judge Keech's decisions. Observers speculated, however, the department might decide to drop the issue in view of the judge's implied criticism of its failure to take timely action.



NEW OUTLET spurs drilling in remote area near New Mexico's awe-inspiring Shiprock. Pipeline completion means . . .

Four-Corners Crude Ready to Move

FOUR CORNERS Pipe Line Co. will start delivering crude oil to Los Angeles refineries about the middle of April.

Work on the $50,000,000 pipeline system from the booming Four Corners area to the Los Angeles refining center was virtually complete last week except for a short segment between Corona and Beaumont, Calif.

The line was originally planned to go into operation about February 1, but completion was delayed by heavy rains in the arid region of southern California.

The 16-in. line, extending approximately 750 miles across rugged mountain and desert country, is the first major pipeline outlet for oil in the rapidly developing fields of the Four Corners area. The main line originates in southeastern Utah's Aneth area near the common corner of Utah, Colorado, Arizona, and New Mexico. Feeder lines will connect other nearby fields in Utah and New Mexico.

Crude oil from fields in both Utah and New Mexico has been flowing into the system for several months. Up to March 15, the line had received approximately 870,000 bbl. of crude and about 175,000 bbl. more was needed for pipeline fill.

First deliveries are tentatively scheduled about April 11-15.

Initial nominations by purchasers call for immediate delivery of about 60,000 bbl. of crude daily. By May 1, a company official announced, the line is expected to be operating at capacity of 70,000 bbl. daily.

First deliveries will go to at least four California refineries. The plants are operated by Standard Oil Co. of California, Shell Oil Co., Richfield Oil Corp., and Union Oil Co.

Standard and Shell each has 25% interest in Four Corners Pipe Line Co., and Richfield has 10% interest. Other owners include Gulf Oil Corp., with 20%, and Superior Oil Co. and Continental Oil Co., each with 10%.

Shell Pipe Line Corp., as agent for the owners, has supervised construction and will operate the line.

Line spurs drilling . . . Work on the line started last spring.

In a recent address before the fourth Conference on Industrial Development at the University of Arizona, Joe T. Dickerson, president of Shell Pipe Line, pointed out that the new line already had contributed to rapid development of fields in the Four Corners area.

"Disclosure of the plan for construction of the pipeline had an electrifying effect upon development activities in the fields, as it assured producers of an outlet for their crude, and an earlier return on their capital investment in wells," he said.

"In the Paradox basin, at least seven additional fields were discovered in 1957, as a result of the drilling of more than 100 exploratory wells. This figure is contrasted with 39 wildcats drilled at Paradox in 1956."

During 1957, Dickerson pointed out, there were an additional 136 development wells drilled in Paradox basin compared with only 15 in 1956.

In the San Juan basin, Dickerson said, 90 wildcats were drilled in 1957 as compared to 65 the preceding year.

"At the start of 1957," he continued, "there were approximately 200 producing oil wells in Northwest New Mexico, and at the end of the year there were approximately 500 producing wells, which means that more than 300 wells have been drilled since the announcement of the pipeline outlet."

Because of sparse drilling and lack of a market for the crude, neither the reserves nor productive capacity of the Four Corners can be accurately forecast.

Until Four Corners started filling its pipeline late last year only a few thousand barrels of crude per day moved from the area by pipeline. That went through El Paso Natural Gas Products Co.'s line to its nearby refinery.

Because of the high costs of trucking the crude to market, there was little demand for remainder of the available production.

Second line under way . . . The real

test of the area's potential production may come this summer when Texas-New Mexico Pipe Line Co. completes its new crude system. This line will extend from Aneth field southeastward across New Mexico to Jal.

The Texas - New Mexico system, with a capacity of about 50,000 bbl. daily, will give the new Four Corners field a rival crude outlet. Texas-New Mexico is owned by The Texas Co., Sinclair Pipe Line Co., Tidewater Oil Co., and Empire Gas & Fuel Co. (Cities Service Co.).

The line is expected to be completed about midsummer. It will tie in with existing pipelines to move Four Corners crude to refineries either in the Mid-Continent or Gulf Coast areas.

Alberta Bids Sag

due to low Ontario demand. U. S. Northwest also down.

ALBERTA'S crude-oil production will drop in April to its lowest point in 3 years.

Refiners using Alberta crude have nominated only 271,948 bbl. daily during the month, down 39,643 bbl. daily from the March demand. U. S. refiners will take 40,420 bbl. daily.

Records disclose that not since April 1955, when nominations totaled 243,985, has the figure been lower than it will be in April.

The best month the Alberta oil industry has had in its history was December of 1956 when refiners took a record 447,896 bbl. daily.

While there is a small drop in demand of the Pacific Northwest area of the U. S., most of the blame for the April decrease falls on Ontario, where the nominations are only 75,230 bbl. daily compared with 98,150 for March.

Refiners in the Great Lakes section of the U. S. will take 1,032 bbl. daily more than they did in March. Alberta refiners increased their March bids by 5,490 bbl. and Saskatchewan refiners by 2,085 bbl. The U. S. Northwest demand was cut by 8,431 bbl. daily.

Following is a tabulation of the nominations for April submitted by U. S. refiners: General Petroleum Corp., Ferndale, Wash, 17,500; Shell Oil Co., Anacortes, Wash, 9,800; International Refineries, Wrenshall, Minn., 6,000; Lake Superior Refining Co., Superior, Wis., 4,000; Bay Refining Corp., Bay City, Mich., 3,000; and Union Oil Co., Cut Bank, Mont., 120.

Computer + Men Equals Profit

THE REFINING industry probably could improve its profit picture by hiring a few more technical men. And a wider use of computers in simulating and optimizing operations also could bring higher returns.

These conclusions emerged from a study of the profit-making functions in refining. They were reported to the Western Petroleum Refiners Association last week by L. D. Stewart of D-X Sunray Oil Co.

The study looked at the relative share of seven major refining functions which bear directly on profits. Each was evaluated and assigned a cents per barrel figure for a hypothetical 100,000-bbl. refinery making 50 cents per barrel profit.

In relating these functions to technical manpower requirements, the study arrived at a theoretical figure of 148 men per 100,000 bbl. of capacity for maximum return on overall operations inside the refinery gate. This is roughly eight men above the average, according to an accompanying survey of 11 companies which account for 20% of U. S. capacity.

Role of computers . . . In his report, Stewart referred again and again to the potential of computers. One of the seven functions he listed was the optimum economic simulation of refining processes, stream routings, and products distribution for maximum return.

Beyond this obvious use, computers promise greater return in other functions. Crude evaluation, for example, can be done more realistically by combining laboratory analysis with a computer programed to represent the processing model of the refinery.

Again, in evaluating technical process efficiency, computers can add to profits by correcting the relationships of pilot-plant results to commercial operation. These corrected correlations can then be fed to a computer to arrive at optimum operation of a unit either for maximum profit or most desirable product distribution.

Process research and refinery expansion received top position as functions of profit. Again, in planning expansion on a given budget, technical men face the problem of deciding which unit in a program should be built first. By including current product price structures with technical correlations on production, computers can be programed to give timely answers to the question of which unit will pay out in the shortest period of time.

The right slots . . . Stewart recommended that refiners place their technical men in positions where they will be most valuable. The study, laid side-by-side with the manpower survey conducted among the 11 WPRA member companies, indicated that some manpower shifts might be in order.

If the survey represents the industry in general, management might well look into the possibility of shifting some process engineers from straight design work to other duties. Process simulation, crude purchasing, and efficiency improvement of existing units appeared to be undermanned, technically.

With management lies the responsibility not only for hitting peak efficiency in all profit-making functions but also for coordinating them.

All such functions are interrelated, Stewart concluded. Management must recognize this and make certain that developments in one refinery department are carried through to higher profits in other related divisions.

New Line Approved

for El Paso. But a part of application held up by FPC.

A $138.5-MILLION pipeline project permitting El Paso Natural Gas Co. to supply an additional 185 million cubic feet of gas daily to customers in Arizona and California was approved last week by the FPC.

The project includes the building of 216 miles of main pipeline and 58,900 hp. in compressor facilities, plus 533 miles of field lines and 27,850 hp. in Arizona, Texas, and New Mexico, at an estimated cost of $107.1 million.

Another $31.4 million will be spent on 266 miles of pipeline, 8,920 hp., and dehydration, metering, and other equipment for use in supplying up to 100 million cubic feet daily to a new Los Angeles customer, Southern California Edison Co.

However, the building of 126 miles of main pipeline to complete this part of the project was held up.

The FPC explained that El Paso's applications were opposed by the staff on the ground of insufficient gas supplies. There was doubt that the company has shown its ability to meet its system requirements after 1963.

The question has been sent to an examiner for investigation and report before the FPC takes action on the facilities it suspended.

Arctic Attracts Four Firms

A NEW LAND play in extreme northern Canada could touch off an exploration program along the remote Arctic Coast of Yukon and the Northwest Territories.

Four companies have asked the Canadian Government for permits covering 8,000,000 acres in the Mackenzie Bay area. Other companies are reportedly interested in acreage in the same region. Separate permits are sought by:

. . . **British American Oil Co.,** Ltd., for 2,800,000 acres northeast of Aklavik.

. . . **Pan American Petroleum Corp.,** for 1,900,000 acres northwest of Aklavik.

. . . **Shell Oil Co.,** of Canada, Ltd., 2,900,000 acres in the Mackenzie River Delta between acreage sought by British American and Pan American.

. . . **Charter Oil Co.,** Ltd., and associates, 400,000 acres intermingled among the acreage sought by the other three firms.

Approval of the permits by the Department of Northern Affairs is considered only a formality. Under new regulations now being set up by the department, first year rental on each new permit would call for a $25 fee. Each permit contains about 47,000 acres.

Drilling would have to be carried out during the short summer season. However, no drilling plans have been announced. A big question would be moving production to market.

Remote locale . . . The potential of the area is relatively unknown because of the geographic location, distance from markets, and lack of detailed geological data.

The acreage requested by the four companies stretches for almost 200 miles along the Arctic Coast starting at a point about 40 miles east of the Alaska-Canadian border and extending about 75 miles east of the trading post of Aklavik. Some islands in Mackenzie Bay are included.

Nearest production is about 290 miles southeast of Aklavik at Norman Wells where Imperial Oil, Ltd., has production in the Devonian. The crude is refined at Imperial's 1,300-bbl. refinery at Norman Wells.

During World War II, the Canol pipeline was built from the refinery to Alaska, but when shipments through the line were discontinued, refinery output was once more geared to local demand.

Imperial discovered production at Norman Wells in 1920. Development was spurred during the war, but wasn't revived again until 1956, when Imperial launched a four-well drilling program. At that time, 20 wells were producing about 1,000 bbl. daily.

Growing interest . . . Since the war, Imperial has explored 75,000 miles of Arctic land (OGJ, Aug. 27, 1956, p. 77).

Last year, Peel Plateau Exploration, Ltd., announced plans to test an 8,000,000-acre concession in the Northwest Territories and Yukon. The acreage is just south of Aklavik near Fort McPherson (OGJ, Jan. 21, 1957, p. 73).

Canadian Husky Oil, Ltd., began geological work last summer on a 4,700,000-acre area about 75 miles southwest of Aklavik (OGJ, July 22, 1957, p. 55). Last year, Canadian officials announced plans for a helicopter survey of 100,000 sq. miles in the Upper Mackenzie River area to determine the region's potential (OGJ, Jan. 21, 1957, p. 67).

Shale Land May Be Leased

ANOTHER GOVERNMENT venture in oil-shale research is under study in Congress.

The new program, however, is designed to be carried out without cost to the Government. It calls for the leasing of shale lands and the research plant formerly used by the Bureau of Mines at Rifle, Colo., to private interests.

A bill giving the Navy clear-cut control of Naval Oil Shale Reserves Nos. 1 and 3 in Colorado has been offered in the Senate by Sen. Gordon Allott (R-Colo.). A similar measure is to be put in the House mill by Rep. Carl Vinson (D-Ga.), chairman of the armed-services committee.

The Allott bill is designed to meet an opinion by Atty. Gen. William P. Rogers earlier this month, that the Navy now is without power to lease the lands.

Rogers held that the department's leasing authority in the government reserves was limited to the petroleum lands.

The attorney general refused to pass on the question of whether the Navy or Interior has title to the Rifle plant built by the latter during its 11-year research program on which it spent some $23.5 million. The plant presumably would pass to the Navy with other authority in the Allott bill, but Rogers said the question was not now actively in issue.

Rogers also refused to rule on whether the Navy, if given control of the reserves and plant, would be required to lease them. That, he said, is a matter of executive policy.

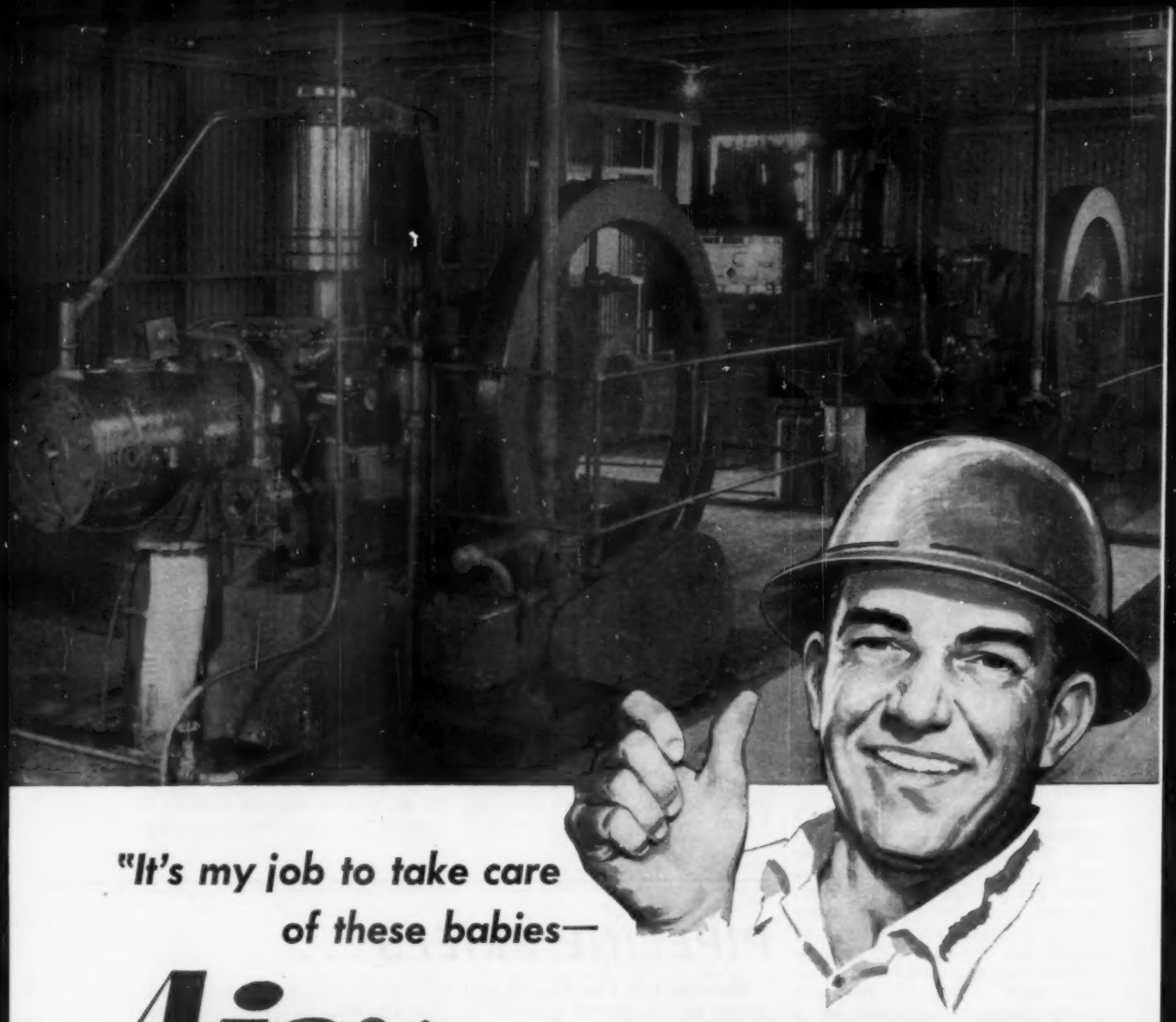
Navy's view . . . The Navy's ideas for further study of oil from shale were laid before Congress a year ago. At that time, the department offered a choice between a lease to private interests who would carry on the study or a 5-year research contract to cost $14 million.

The idea of spending more government money on the project didn't appeal to Vinson. But he made it clear that he would like to find out if the shale reserves have any military value.

Navy spokesmen have said the Navy's interest in shale is based on wartime needs for fuels.

The Navy is looking for a new major source of heavy-fuel oil, to be counted as part of the West Coast fuel supply in another war.

Navy shale reserves in Colorado and Utah were originally estimated to hold 22.5 billion barrels of oil. A later estimate by the U. S. Geological Survey, however, places nearly 1 trillion barrels in a 1,400-sq.-mile area in the Piceance Creek basin of Colorado alone.



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LPG Floods Look Good

. . . in the field. AIME reports indicate promising future for new secondary-recovery tool, despite limitations.

EARLY RESULTS from a number of miscible-phase displacement projects are confirming what operators had already learned from laboratory tests:

The new secondary-recovery method has a promising future where reservoir conditions are suitable and where nearby supplies of LPG and natural gas are available.

But the process has limitations and is not universally applicable. A successful project requires thorough evaluation of geologic characteristics and the many interlinking factors of reservoir behavior.

Partial results of current projects in Texas, Oklahoma, and New Mexico were reported in six papers presented at a recent regional conference of AIME's Society of Petroleum Engineers in Tulsa.

Actual results . . . Summarized here are the results of six projects which were the subject of papers at the recent AIME meeting:

. . . Humble Oil & Refining Co.'s Seeligson field project in Kleberg and Jim Wells counties, Texas. This project, using a propane-enriched gas drive, was reported by H. T. Wright, Jr., and R. R. Die, Corpus Christi.

The program began about 10 months ago. The Zone 20-B reservoir was selected for several reasons: Propane supply is available from two nearby plants; the reservoir has a reasonable configuration, comparatively uniform sand, and adequate development; and saturated crude from this reservoir is similar to other reserves in the area.

About 420,000 M.c.f. of gas and 290,000 bbl. of propane have been injected. The company plans to continue injection until the first row of producing wells has been bypassed. Then it will be decided whether to inject dry gas for displacement of the enriched gas. As the enriched gas passes the last row of producing wells it is planned to recover propane by pressure depletion or cycling of dry gas.

Meanwhile, monthly tests are made on the first row of producing wells to provide information on advance and composition of the enriched gas front. A core well was drilled 100 ft. downstructure from an injection well to provide information on displacement efficiency. Areas of reasonable permeability have been completely swept of oil. The tight sections of sand had minimum oil saturations.

. . . Carter Oil Co.'s C-2 Block in Seminole County, Oklahoma. This project uses the low-pressure partially miscible gas-driven propane slug method. The propane is miscible with the oil but not with the driving gas.

In their report, R. E. Walker, J. D. Engel, and L. H. Jenks, Tulsa, outlined results of the 5-year-old test. First the reservoir was repressured to approximately the vapor pressure of propane. Then 143,000 bbl. of liquid propane was injected at two wells. Water injection set up a water barrier to obtain at least partial confinement of the test area (OGJ, Dec. 9, 1957, p. 80).

Gas drive was started in 1954. By December 1957, about 580,000 M.c.f. of gas had been injected. Breakthrough of injected propane into all five test wells occurred right after gas drive started.

At the end of 1957, nearly 73,000 bbl. of propane had been produced, for an over-all oil-propane ratio of 1.95 bbl. of oil per barrel of propane. Oil production has totaled 142,000 bbl. Average well production has been slightly over 100 bbl. daily with gas-oil ratios averaging much below the final primary gas-oil ratio. Since only partial confinement could be obtained, this is an encouraging response.

The test showed that large quantities of propane could be gas driven without severe channeling. Under the test conditions, the method appears to be more effective than conventional secondary-recovery processes.

. . . Sunray Mid-Continent Oil Co.'s Bisti project in northwestern New Mexico was started last August (OGJ, July 22, 1957, p. 51). R. E. Brooks, Tulsa, reported that injection of butane was followed by butane-propane mix, and then propane alone. Gas injection was started in late September.

High producing rates have been maintained in three of the four producing wells without noticeable increase in gas-oil ratio. So far, results are encouraging, but complete evaluation is not yet possible.

. . . Magnolia Petroleum Co.'s Parks Pennsylvanian project, Midland County, Texas, is a field-wide propane slug injection program (OGJ, Sept. 9, 1957, p. 58). D. G. Marrs of Magnolia pointed out that the project has been under way about 10 months. The last of the propane slug will probably be injected this year. There has not been

PIPELINE BRIEFS . . .

Plantation Pipe Line Co. will start in May on a $2,440,000 expansion of its products system involving work at 12 pump stations. The expansion will raise capacity 29,000 bbl. daily and will permit movement of 334,000 bbl. daily out of Baton Rouge, La., for delivery at terminals in Mississippi, Alabama, Georgia, Tennessee, South Carolina, and North Carolina.

Larger pumps, motors, and auxiliary equipment will be installed at Baton Rouge; Collins, Miss.; Vincent and Heflin, Ala.; Bremen, Doraville, Winder, Athens, and Hartwell, Ga.; Anderson, Simpsonville, and Spartanburg, S. C.

Panhandle Eastern Pipe Line Co. will lay 193 miles of gathering lines this year in Kansas, Oklahoma, and Texas. Some 95 miles of 4-in. is contracted to Hall Construction Co. Panhandle Eastern also plans 45 miles of 6-in., 38 miles of 8-in., 3 miles of 10-in., and 12 miles of 12-in. gathering lines. In addition a 33-mile, 16-in. line will be laid by September 1 from Muncie, Ind., to Hollansburg, Ohio.

Interstate Oil Pipe Line Co. has started work on a 16-mile, 4-in. LPG line from Baton Rouge to Plaquemine, La., to be completed June 1. J. C. Campbell Construction Co. is the contractor. Interstate will add a 2,500-hp. pumping unit to its Montana crude system by July 1 at the Silver Tip station in Carbon County.

Ohio Fuel Gas Co. plans 76 miles of 8 to 20-in. gas line, mostly in short sections, to improve its transmission system in Ohio. None of the projects has been awarded yet. Completion is scheduled from July to October for the various jobs.

Trans-Canada Pipe Lines, Ltd., is building six compressor stations totaling 48,500 hp. this year. The gas line, starting at the Alberta-Saskatchewan border and completed to Port Arthur, Ont., last winter, was able to operate on field pressure and meet first-year

a decrease in gas-oil ratio nor an increase in oil production rate. Propane breakthrough has not occurred in any of the producing wells.

... **Cities Service Oil Co.** is operator of the Hughey "B" lease project of the West Pampa Repressuring Association in Panhandle field, Gray County, Texas. The slug method was begun last August with injection of liquid butane through one well (OGJ, Aug. 12, 1957, p. 70).

J. L. Relph, Russell, Kans., said there has been increased oil production in some of the producing wells in the pilot area, but ultimate recovery or economics cannot yet be predicted.

... **Atlantic Refining Co.'s** Block 31 Devonian project in Crane County, Texas, is creating the miscible effect with high pressure. This program has been under way since 1949 (OGJ, Mar. 11, 1957, p. 97). L. R. Kern, O. K. Kimbler, and R. Wilson, with Atlantic in Dallas, reported the loss of injected gas because of faulty cement jobs. Radioactive tracer tests were developed to track down the bad cement jobs.

The authors said that in over 80% of the injection areas, repressuring is proceeding as predicted, and that overall field performance in the past year is satisfactory.

Other projects . . . Other fields where miscible drive is being tried include:

... **Sun Oil Co.'s** Millican Reef field project in Coke County, Texas. This project is being carried out with the LPG-slug technique (OGJ, Dec. 2, 1957, p. 59).

... **Continental Oil Co.'s** 640-acre pilot project at Short Junction field, Oklahoma. Here propane and butane injection is followed by natural gas (OGJ, July 22, 1957, p. 50).

... **Cities Service Oil Co.'s** second miscible-phase project is under way in Wilbarger County Regular field, North Texas (OGJ, Oct. 14, 1957, p. 117).

... **Humble Oil & Refining Co.** is using the condensing gas-drive method at its Bronte field project in Coke County, Texas (OGJ, Mar. 11, 1957, p. 98).

... **Humble Oil & Refining Co.'s** condensing gas-drive project in Pickton field, Hopkins County, Texas.

... **Condensing gas-drive** project in Haynesville and Cotton Valley fields, Louisiana.

... **International Petroleum Co.,** Ltd., miscible slug project in San Pedro Block D, Peru.

... **Atlantic Refining Co.'s** high-pressure project in Neale field, Beauregard Parish, Louisiana (OGJ, Mar. 11, 1957, p. 97).

Utes to Take Bids

on acreage near tight holes. Larger royalty is sought.

THE SOUTHERN UTE Indians will receive oil and gas leasing bids April 22 on nearly 50,000 acres of Four Corners land, much of which is located near two tight holes where good discoveries are suspected.

The Consolidated Ute Agency is offering 65 tracts in San Juan County, Utah, and Archuleta and La Plata counties, Colorado. The bids will be opened at 2 p.m., April 22, at the agency office at Ignacio, Colo.

Interest is expected to run high at the sale because 27 of the tracts are located in the same township in San Juan County where Continental Oil Co. has two supertight wildcats.

The Utes are asking 16⅔% royalty on all but 8 of the 65 tracts in the sale. This is the first time the larger royalty has been applied to a Ute sale. The other eight tracts will draw the usual 12½%.

The larger royalty applies to all San Juan tracts, located northwest of Aneth field.

Continental's tight holes are in Township 38s-22e. If they prove to be successful, they will extend San Juan basin production 8 to 14 miles to the northwest.

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delivery requirements. Stations are being built at Burstall, Sask., the originating point, 10,200 hp.; Caron, Sask., 10,200 hp.; Moosomin, Sask., 10,200 hp.; Winnipeg, Man., 7,500 hp.; Port Arthur, Ont., 5,000 hp.; and North Bay, Ont., 5,400 hp. The remaining 852 miles of the Alberta-Montreal are under contract and will be completed by this fall.

Lone Star Gas Co. plans to lay 94 miles of 6 to 16-in. pipe this year in Texas. A 31-mile, 16-in. line now under way in Freestone and Limestone counties will be completed April 1. Other projects include 18 miles of 6-in. loop in Hamilton County, 11 miles of 12-in. near Abilene, 12 miles of 12-in. in Haskell County, and 22 miles of 20-in. loop in Henderson and Navarro counties. An 880-hp. compressor unit will be built in Clay County at the Ambassador field gas storage. Company personnel will handle all line and station construction.

Consumers Power Co., Jackson, Mich., has completed a 40-mile, 12-in. line from Overisel field to Kalamazoo and plans a 45-mile, 24-in. line from the field to the Lansing gas system. The project is to be completed by September 1.

Sinclair Pipe Line Co. will install 4,000-hp. at its Colonels station near Teague, Tex., and 2,450-hp. at its Hensley station near Jacksboro, Tex., in connection with its modernization from North Texas to the Gulf Coast. The Hensley project is to be completed November 15 and the other by January 1. Sinclair expects to have its 150-mile, 20-in. line from Teague to Houston in the ground by July 1.

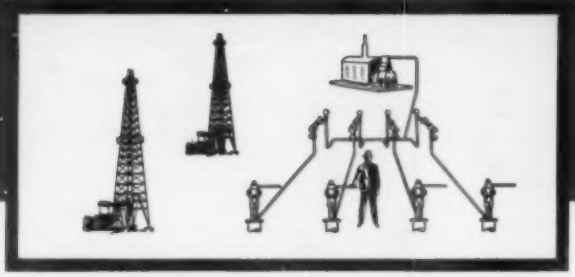
Trans-Northern Pipe Line Co. is increasing the capacity of its Montreal-Toronto products system. A 1,000-hp. pumping unit has been installed at Morewood, Ont., station. A 300-hp. unit will be installed at Clarkson, Ont., by May 15, and a 1,200-hp. unit at Port Credit, Ont., by July 15.

Also for Pipeliners . . .

IN THE NEWS: Texas Gas Transmission may be a source of gas in the plan to move liquid methane to Europe. A Texas Gas line crosses the area in southern Louisiana where Constock Liquid Methane Corp., a Continental Oil Co. affiliate, plans a barge slip and dock (p. 52) . . . Pipelines won a major battle last week when a federal judge threw out three Justice Department complaints which charged the lines were violating the 1941 consent decree (p. 55) . . . The Four Corners crude line will start moving crude within a few days (p. 56) . . . El Paso Natural has signed up a new customer in California and won approval for an expansion (p. 57) . . . Creole will use 40-in. pipe in its Maracaibo gas-gathering system (p. 66) . . . A. O. Smith's Houston pipe mill is back on production after receiving two big orders.

PLUS THESE TECHNICAL REPORTS: A new pipeline analyzer will speed up flow computations (p. 82) . . . Pipeline-construction report (p. 103).

WATCH SARGENT PUMP PERFORMANCE



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Octane Rise Seen

by Du Pont because of new part-throttle requirements.

THERE'S NO REST for refiners. They have been beset by rising octane requirements from higher compression ratios and preignition.

Now they can look forward to another factor—part-throttle requirements which may raise the octane ante they will have to meet in new cars.

This news was contained in a report on new engine fuel trends by three Du Pont engineers at last week's WPRA meeting.

Traditionally, part-throttle operation has always needed less octane than measured by both procedures used in rating road octanes today. But this traditional relationship was reversed in 7% of last year's cars which were found to be part-throttle limited on octane.

This year it appears that as many as 20% may show maximum octane needs at part throttle.

Since much of the driving on today's congested roads is at part throttle, this spells more trouble for refiners. Their gasoline blend stocks are affected differently by these engine operating levels.

Part throttle severely depreciates cat-cracked gasoline from 1.5 to 7 road octane numbers. Cat reformates may rate from 2 numbers lower to 3 higher than full-throttle operation. Alkylate shows about the same rating when stepping on the gas part way and all the way.

These signs of things to come are indicated in today's engine and gasoline trends, concluded the Du Pont authors. Premium-grade gasoline will become less sensitive in the future. On the other hand, the sensitivity, or spread between research and motor octane ratings or regular grade, will tend to increase. Lower sensitivity fuels are generally superior under part-throttle rating conditions.

NGAA to Meet

THE PROGRAM-PACKED thirty-seventh annual meeting of the Natural Gasoline Association of America will be held in Dallas April 16-18.

The convention will begin with committee meetings the morning of April 16, followed by the first of five forums.

Wednesday Afternoon, April 16
Forum on Chromatography

"Chromatography on the Pacific Coast," a report of CNGA activities; "Chromatography as a Guide to Fractionator Operation," A. B. Altom, Warren Petroleum Corp.; "Use of Chromatography as a Laboratory Control Instrument for Plant Operation," L. N. Locke, Continental Oil Co.; "Use of Gas Chromatography in a Refinery Laboratory," J. F. Hickerson, Humble Oil & Refining Co.

"Gas Analysis by Chromatography and Interpretation of Chromatographs," M. F. Deavours, Superior Oil Co.; "Application of Gas Chromatography in a Crude Oil Production and Research Laboratory," Ralph Styring, Atlantic Refining Co.; "Laboratory Analysis of Natural Gas by Chromatography," Dan Smith, Phillips Petroleum Co.; "Automatic Chromatographic Analyzers for Process Monitoring and Control," Mel Fourroux, Phillips Petroleum Co.

Forum on Communications and Organization

"Training and Development," R. L. Switzer, Atlantic Refining Co.; "The Negotiation and Administration of Labor Agreements," H. R. Shepherd, Cities Service Oil Co.; "The Interdependence of Organization and Communications," J. N. Beasley, Humble Oil & Refining Co.; "Delegation of Authority," Ed McCleskey, Tennessee Gas Transmission Co.

Forum on Motor Fuels and Engines

"Engines and Fuels," T. W. Legatski, Phillips Petroleum Co.; "Potential Application of Manganese Anti-Knock Compounds in Natural Gasoline," M. W. Sabin, C. J. Wolfe, and R. J. Riggs, Ethyl Corp.

Thursday Morning, April 17
Forum on Cutting Plant Costs

"Economy Begins With Plant Design," N. C. Turner, Hudson Engineering Co.; "Cost Reduction and Increased Recovery Through Plant Modifications," V. E. Middlebrook, consultant; "Minimizing Plant Operating Costs," R. F. Naul, The Texas Co.; "The Human Side of Job Planning," E. Y. Palmer, Atlantic Refining Co.

Forum on New Design Trends

"Use of Business Machines in Design: Fitting 'K' Charts to Computers," R. L. Norman and Dr. Brymer Williams, University of Michigan; "Practical Applications of Computers in Engineering Design of Gasoline Plants," R. L. McIntire, The Datics Corp.; "Treating High CO_2 Content Gas," R. B. McLaughlin, Northern Natural Gas Co.; "Hot Potassium Carbonate Removal of CO_2" B. O. Buck, Petrocon Engineering Co.

Thursday Afternoon, April 17
General Session

President's Address, George T. Tennison, Shell Oil Co.; "Conservation of Natural Gasoline in Texas," Gen. E. O. Thompson, Texas Railroad Commission; Address, Ernest G. Swigert, Hyster Corp.

Friday Morning, April 18
General Session

Report of the Technical Committee, Charles E. Webber, Sun Oil Co.; "Implication of Continued FPC Regulations," J. F. Jones, Pan American Petroleum Corp.; "Future Use of Natural-Gas Liquids in Petrochemicals," Anson P. Hobbs, Dow Chemical Co.; "Processiing of Light Ends Into Petroleum Fuels," Universal Oil Products Co.

Research Meeting

THE TEXAS Petroleum Research Committee will hold its eleventh Oil Research Conference at the University of Texas, May 8-9.

Texas' Gov. Price Daniel will open the conference at Townes Hall. Public officials will do most of the speaking at the morning session, while production problems will be discussed by industry speakers during the afternoon and the following day.

Theme of the conference will be "A Century of Texas Oil, 1875-1975."

May 8, 9:30 a.m.-12 noon

Opening remarks, Gov. Price Daniel.

"Three-Quarters of a Century of Texas Oil," Charles Warner, Houston.

"The Railroad Commisison and Texas Oil," Olin Culberson, chairman, Texas Railroad Commission.

"Conservation on University and Public Lands," Bill Allcorn, Texas Land Commissioner.

"Importance of Petroleum to Texas A. and M. College," T. W. Doherty, Houston, Texas A. and M. Board of Directors.

May 8, 5 p.m.

"Some Trends in Petroleum Research," Dr. Carl Tonberg, Carter Oil Co., Tulsa.

"Petroleum Engineering Education of the Future," Dr. John C. Calhoun, Texas A. and M.

"Applications and Limitations of Fluid Injection for Oil Recovery," George Roberts, Jr., Pan American Petroleum Corp., Tulsa.

"Nuclear Application in the Production of Oil, Now and in the Future," Abel DeHaan, Tracerlab, Inc., Richmond, Calif.

"Recent Progress in Oil Recovery by In Situ Combustion," J. S. McNiel and J. T. Moss, Magnolia Petroleum Co., Dallas.

May 9, 9 a.m.-12 noon

"Future of Oil and Gas in Texas," Dr. Richard T. Gonzales, Humble Oil & Refining Co., Houston.

"Oil Recovery of the Future," Norman J. Clark, Core Laboratories, Inc., Dallas.

"Industry's Drive for Maximum Recovery," Vern Stepp and Dr. Eugene Brownscombe, Atlantic Refining Co., Dallas.

"Trends in the Completion and Production of Oil and Gas Wells," T. A. Huber, Humble Oil & Refining Co., Houston.

"Miscible-Phase Flooding," R. B. Chapman, Jersey Production Co.

May 9, 1:30-4 p.m.

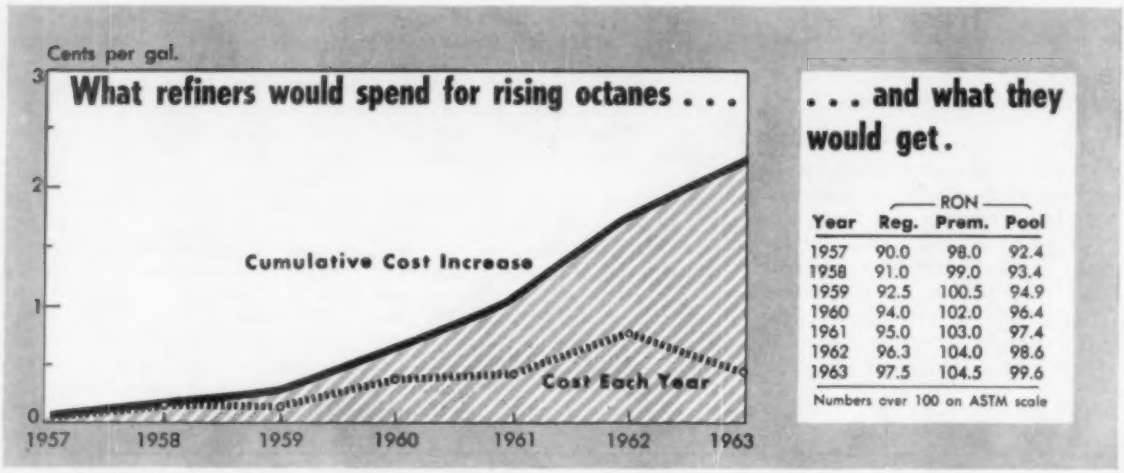
"When Should a Producing Well be Converted to a Water Injection Well?", Dr. Paul B. Crawford, TPRC, Texas A. and M.

"Effect of Gamma-Ray Radiation on Normal Hydrocarbons," George W. Crawford and James F. O'Briant, TPRC, University of Texas.

"Effect of Saturation with Various Gases on the Viscosity of a Viscous Crude Oil," George W. Crawford and L. R. Dickerson, TPRC, University of Texas.

"Asphalt Deposition During Miscible Displacement of Crude Oil by Propane," Dr. Paul B. Crawford, TPRC, and Prof. R. B. Bossler, both of Texas A. and M.

MEETING PROGRAMS



. . . and what they would get.

Year	RON Reg.	RON Prem.	Pool
1957	90.0	98.0	92.4
1958	91.0	99.0	93.4
1959	92.5	100.5	94.9
1960	94.0	102.0	96.4
1961	95.0	103.0	97.4
1962	96.3	104.0	98.6
1963	97.5	104.5	99.6

Numbers over 100 on ASTM scale

Quality Gasoline to Come Plenty High

Refiners can reach much higher octane levels—but only with many changes in processing and a lot of money. Here's an idea of what's in store in the next 5 years if plants are to keep up with the demand for better and better fuels.

THE ROUTE to higher octane levels will be a costly one. Refiners can look forward to spending more than 2 cents a gallon to raise their motor fuels to octane levels anticipated by 1963.

At that time the research octane number of the motor-gasoline pool will be 99.6, up sharply from a 93.4 level this year. Regular grades will advance from 91.0 this year to 97.5 in 1963, while premiums will rise from 99.0 to 104.5, based on the ASTM scale.

Present processes make the increased octane level technologically possible. The main concern of the refiner is to find the cheapest way of reaching this level.

Economic guideposts were outlined in a paper presented by members of the Western Petroleum Refiners Association at the San Antonio annual meeting. W. J. Service, R. E. Payne, and W. E. Askey, all of Pace Co., Houston, made the study.

The authors started by arbitrarily selecting a 50,000-bbl. Gulf Coast refinery charging West Texas sour crude. They then traced the most economical and practical ways to upgrade the gasoline quality.

The base plant contained these processing units: two-stage crude still, naphtha desulfurization, catalytic reformer, cat cracker, thermal cracker, cat polymerization, middle distillate hydrotreating, and necessary light-end and distillation facilities.

In the study, 30% of the gasoline was blended to premium quality.

First step . . . The refiner was able to meet the single octane number increase from 1957 to 1958 by simply increasing cat reformer severity from 85 RON to 92 RON clear.

In 1959, a 1½-octane rise could be met with a modest revamp of the reformer to permit operations at a reduced reactor pressure of about 350 psig. It also would be necessary to raise reforming severity again to produce a 96 RON clear reformate.

Another 1½-octane increase in the 1960 grades would require higher reformer severity. But it wouldn't yield enough stocks for premium gasoline building. So fractionation equipment would have to be installed to permit light cat naphthas and heavy reformates to be pulled off and blended into premium grade.

While research octane number was being maintained by these methods, road octanes would not be keeing up the pace. Hence, the authors decided to bring alkylation into the motor fuel picture for 1961. At the same time, reformer severity was increased to its maximum level of 98 RON.

The only low-octane streams remaining in motor gasoline in this typical 1961 refinery would be the C_5-200° F. virgin naphtha and thermal naphtha. The most practical means of handling these stocks is to depentanize, hydrodesulfurize, and catalytically reform them in admixture. A new reformer would be required. Finally, by 1963, this refiner would have to go to isomerization of his pentanes.

Other findings . . . Analysis of octane improvement methods studied showed these hightlights:

. . . Addition of TEL. This is recognized as one of the cheapest ways of increasing octane number. However, as the amount of tetraethyl lead reaches its maximum concentration of 3 cc per gallon, octane number by this method becomes more costly.

Also, as the pool octane level increases, the effectiveness of the TEL decreases. In the study, cost of octane improvement via TEL varied from 4 to 15 cents per research octane number barrel.

. . . Catalytic reforming. In the base refinery, a nonregenerative, platinum catalyst reformer charging 200°-375° F. virgin naphtha and operating at 500 psig., was installed.

Economically, as pool octane number increases, the cost of reforming for octane improvement goes up. Likewise, as reforming severity level increases, the cost per RON barrel also goes up.

One way to increase effectiveness of motor gasoline production by cat reforming is to decrease average reaction pressure. Gasoline yield at constant octane number will then increase. Unfortunately catalyst deac-

tivation by coke formation will also increase. The authors suggested the possibility of installing a regeneration unit to permit reduced pressure operation.

Extraction of aromatics and recycling the low octane number raffinate was viewed as technically practical but not competitive when reforming the West Texas naphtha. Charging C_6-200° F. naphtha mixed with thermal naphtha was another possible route proposed. This costly process, however, would range from 15 to 30 cents per RON barrel and couldn't be justfied without a gasoline price increase.

. . . Alkylation. Replacement of polymerization by alkylation is important to avoid depreciation of the road octanes. Propylenes and butylenes and possibly pentylenes would serve as feed stock. The alkylate product, while costly, improves the depreciation aspect of the blend and can't be neglected.

. . . Isomerization. Cost of octane improvement via this route would be quite costly, amounting to 31.4 cents per RON barrel. This wasn't believed necessary until 1963.

. . . Hydrodesulfurization. Technologically, hydrogen treating of cat cracker feed stocks shows possibility of increasing the yield and quality of naphtha product. Desulfurized feed produces considerably more gasoline and heating oil at the expense of heavy cycle stock. Additionally, the gasoline has octane numbers 1-5 units higher than that produced otherwise.

The authors couldn't justify a unit for this purpose at the typical plant until 1964-68, provided that octane numbers continue to increase during that period.

. . . Segregation of components. While this method doesn't produce any octane numbers, it allows proper distribution of those produced in conversion units. Probably the simplest method is to distill the cat naphtha and cat reformate.

The front end of the cat naphtha has a higher octane number than the average, while the back end of the reformate has a considerably higher octane number than its front end. Extraction of aromatics would achieve the same purpose but would be quite expensive.

The typical 50,000-bbl. refiner, to keep pace for the next 10 years, would have to spend $8.3 million. The price of gasoline, meanwhile, would have to increase about 2.2 cents per gallon to pay for the increased octanes, the authors concluded.

UOP Reveals New Processes

REFINERS now have a chance to assess the merits of two process techniques which drew interest at last week's meeting in San Antonio of the Western Petroleum Refiners Association.

H. W. Grote of Universal Oil Products Co. took the wraps off the Butamer and Alkar processes.

Butamer isomerizes normal butane to isobutane. Alkar makes a variety of alkylated aromatics. Technical details of the processes will be found starting on page 73 of this issue.

Grote explained Butamer offers a low-temperature, low-cost route to isobutane for large and small refiners who are boosting alkylation operations to a point where extra isobutane will be needed.

The process uses a specially prepared platinum-containing catalyst, said Grote. Incorporating recycle of unconverted normal butane, the process shows a yield of 100.3 volume per cent including small amounts of pentane, largely isopentane.

Unit costs will range from $800 down to $400 per daily barrel of isobutane for plants in a capacity range that interests most alkylating refiners. Total production costs, including reasonable investment payout rates, will run about 3 cents per gallon on the average.

Alkar, said UOP, will open up a brand new source of refinery gas to commercial use in making petrochemicals. In the gas streams coming from the nation's cat crackers and other conversion units, about 1½ billion pounds of ethylene are burned every year, as low valued fuel.

But ethylene and propylene are present in such low concentrations that recovery has proved uneconomic. Alkar will permit the combination of olefins as they occur in these gas streams. They become higher valued ethyle benzene and cumene through catalytic alkylation with benzene.

All olefins are converted, and practically no polymers are formed. At current prices for the petrochemical products, a 3-year payout is estimated for Alkar units.

As octanes rise, Alkar may come into use for making very high-octane alkylated aromatics. Low-valued olefins can thus be converted to such high-powered gasoline blend stocks as 115-octane ethyl toluene.

——*Industry* briefs

Lower crude prices were posted last week in widely scattered areas of Texas, Oklahoma, Louisiana, and Kansas. In nearly every instance cuts were made to meet previous reductions by competitors.

Suntide Refining Co. and Republic Oil Co. cut prices in Southwest Texas fields by 10 to 20 cents a barrel. Crown Central Petroleum Co. lowered prices in Iota field, Acadia Parish, Louisiana, by 15 cents. Anderson-Prichard Oil Corp. cut 15 cents from northern Oklahoma and Kansas prices. Skelly Oil Co., D-X Sunray Oil Co., and Magnolia Petroleum Co. all joined in reducing price of southern Oklahoma sour by 10 cents.

Mitchell Engineering Co., London, has completed model tests on an 80,000 to 100,000 deadweight ton nuclear-powered submarine tanker and has begun the design of such a vessel. It would have a top speed of close to 60 miles an hour and would load and unload under water. It would normally carry a crew of five but could operate unmanned with automatic controls.

Louisiana's oil-production allowable for April has been set at 769,617 bbl. a day, an increase of 13,902 bbl. daily over the March total. The increase is allotted primarily to new production.

Humble Oil & Refining Co. has passed the 8,800-ft. mark toward a 12,000-ft. depth objective with its Alaskan Peninsula wildcat in the Wide Bay-Cold Bay area opposite Kodiak Island. The well—only one now active in Alaska—is one of three planned on acreage held by Shell Oil Co. When Humble completes the three wells, it will acquire a one-half interest in the Shell unit.

The current wildcat has a string of protective casing set at 6,516 ft. It is designated Humble-Shell-Bear Creek Unit 1.

Fargo Oils, Ltd., Calgary, has acquired all outstanding shares of Cumberland Investments, Ltd. The deal involved 264,310 gross acres in Alberta, plus varying royalty interests in 12 producing wells and working interests in 8 others.

Fargo's gross acreage now totals 3,144,813 and net acreage is 1,053,852. Earlier this year the company acquired General Minerals Corp., Dallas, in a deal which produced $2,000,000 in cash for Fargo and an income of about $40,000 per month.

PIPE 40-IN. in diameter is loaded for Maracaibo where . . .

Creole to Lay Big-Inch Line

WORK WILL BEGIN next month on a Lake Maracaibo gas-gathering system using the largest-diameter pipe ever installed on such a project.

More than 13 miles of the underwater system will be of mammoth 40-in. steel pipe.

Brown & Root, Inc., Houston, will lay the line for Creole Petroleum Corp.

One of the largest pipe-laying barges ever built, the "M-211," is being towed from Houston for use in constructing the new line.

The barge, in the picture above, is being loaded with more than 2,000,000 lb. of materials and equipment for the job. The vessel is scheduled to reach Lake Maracaibo about April 9 after a 20-day voyage.

The new network will greatly expand Creole's repressuring system in the Venezuelan lake. It will tie in with Creole's Juana Conservation Plant No. 3.

The project . . . The new gathering system will consist of 18 separate lines. They will include 10,153 ft. of 16-in. pipe; 43,400 ft. of 30-in. pipe; and 72,900 ft. of 40-in. pipe.

Lines from the lake bottom will have vertical risers weighing up to 100,000 lb. each. Their installation will require extra heavy derrick equipment. A Brown & Root derrick barge will be towed to Lake Maracaibo from the Gulf Coast to assist in the project. The barge is scheduled to leave about April 7.

Work on the project is expected to begin about April 20. Big-diameter pipe for the system has been procured by Creole and delivered to Venezuela.

The 40-in. pipe, after being reinforced and coated with concrete, will have an outside diameter of 52 in. Each joint will be nearly 40 ft. long and will weigh approximately 20 tons.

The pipe will be processed at recently established Brown & Root yards on the east and west sides of the lake. More than 1,000,000 lb. of reinforcing material will be used. It will include 3,000,000 sq. ft. of steel mesh and 23,000 cu. yd. of concrete.

Before concrete-weight coating, the line will be cleaned with a new pipe shot-blast machine, which Brown & Root claims is the largest ever constructed.

The gathering system will underlie about 100 ft. of water.

Past experience . . . Brown & Root's pipe-laying barge to be used on the Venezuelan job proved itself last year in laying a large line in the Gulf of Mexico for Tennessee Gas Transmission Co. It is equipped with five 40-ton capacity davits, eight 8,000-lb. anchors, and a 710-ft. pipe-lowering pontoon.

The 40-in. pipe will be the longest segment of such large pipe ever used in transportation of oil or natural gas. Steel pipe up to 80 in. in diameter has been used in water lines, but it is believed that the Lake Maracaibo project will be the first to use 40-in. pipe in a high-pressure line.

Navajos Criticized

for delay in rejecting bids. Oil company calls it unfair.

A PROTEST against undue delay in the rejection of lease bids by the Navajo Indians appears unlikely to bring any action by the Bureau of Indian Affairs in Washington.

The protest was filed by Mohawk Petroleum Corp. with both the Navajo Tribal Council and Glenn L. Emmons, commissioner of Indian affairs.

The company protested that a delay of 96 days in rejecting its bid was "eminently unfair." The Indians, Mohawk said, are placing themselves "in a position whereby the oil industry will be reluctant to bid knowing it is subject to such arbitrary and unreasonable treatment."

The company's protest was well taken, Norman M. Littell, general counsel for the tribe, said. But he explained that big business is new to the Navajos and the procedure followed has been cumbersome.

Littell said that steps are now being taken to speed up the consideration of bids and to act on them more promptly.

Costly leases . . . The council this month opened bids in its fourth and final lease sale of a series started last December. Bonus offers ranged as high as $412 per acre and totaled $5.8 million (OGJ, Mar. 24, p. 87). Littell predicted that some of the bids would be rejected, as in previous sales. But he said there will be no 3-month delay as in the past.

The four sales brought the Navajo Indians total bonus offers of nearly $28 million. The first sale last December brought a top bonus offer of $4,038 per acre from Carter Oil Co. This was the highest bid ever received for Indian lands in the Rocky Mountains (OGJ, Dec. 16, 1957, p. 63).

Contempt Case Is Appealed

GULF OIL CORP.'S battle over proration with the Oklahoma Corporation Commission began its official journey through the courts last week.

Gulf filed with the Oklahoma Supreme Court an appeal from a conviction and $305,000 fine assessed by the commission for contempt in failing to obey the August and September allowable orders.

The case is expected to go to the U. S. Supreme Court before final adjudication. The commission contends Gulf should have obtained permission to cut its purchases below the allowable, while the company con-

tends it cannot be forced to buy more crude than it can handle.

The oil industry is watching the case closely because it will settle the basic question of whether a state can compel purchasers to take the full allowable assigned them.

Pipe Mill Reopens

with new orders. Plant had closed because of ruling.

A HOUSTON pipe mill which has been idle since March 1 went back in production last week.

Approximately 300 workers returned to their jobs with A. O. Smith Corp. of Texas to fill two big pipe orders, one from Tennessee Gas Transmission Co. and the other for an unidentified purchaser in Iraq. Both orders were for large-diameter pipe, ranging from about 22 to 30 in.

L. M. Keating, A. O. Smith vice president, estimates the Memphis decision had cost his company $250,000,000 in cancelled orders. The Memphis case has retarded new construction because, under the decision as it now stands, pipelines must get consent of oil customers before increasing rates.

With receipt of the two new orders the Smith plant returned to a normal two-shift operation. The current jobs will keep the plant in operation only until about May 15 or 20. "But we do have some more orders coming up," Keating said.

During the layoff workers were given a 2-week vacation several months earlier than usual.

Drill to Test Historic Site

OIL HUNTERS are returning to the site of what may have been the Western Hemisphere's first commercially successful oil well, drilled 140 years ago.

Barnwell Production Co., Shreveport, announced it has staked the sites for three of five exploratory wells to be drilled on a 230,000-acre lease in Kentucky and Tennessee.

One of the wells will be in the immediate vicinity of a onetime flowing well, drilled in 1818 on the Martin Beatty tract in Wayne County (now McCreary County), Kentucky.

The 1818 well came in 41 years ahead of Col. Edwin L. Drake's discovery at Titusville, Pa., but is not as famous because its owners were drilling for salt water, not oil. Their well went to 200 ft. and flowed 100 bbl. per day for several days. The oil was sold for medicinal purposes.

watching WASHINGTON

... with Bertram F. Linz

● Recession battle plans mapped

THE OIL INDUSTRY and oil men, among others, are almost certain to get a tax break in midyear.

But tax cuts are only part of a plan to combat recession which Congress is trying to draw up.

A wide variety of bills for public works and other actions have been written. Congress is determined to get the economy on the upgrade before the November elections, if possible.

Several of these measures would help oil. One in particular was offered by Rep. Oren Harris (D. Ark.), chairman of the House commerce committee.

The Harris bill would provide government guarantees on equipment loans for the transportation industries. Pipelines and oil bargers, as well as railroads, buses, etc., would be offered this aid, which would make it easier and cheaper for them to borrow money.

The tax cuts haven't been worked out. But corporations may get a two-point reduction. Transportation levies may be halved. Individuals will get either an increased personal exemption or a percentage cut.

If the economy turns upward tax cuts will be out. But if it doesn't Congress, which shows signs of taking the ball from the White House, will lay down its policy late next month.

● Government imports plan killed

DESPITE THE FUROR over foreign oil the Senate this month was offered an idea which could have put the Government into the importing field.

A clause ordering the secretary of agriculture to trade $500 million a year of surplus products abroad for foreign materials to be used by government agencies was slapped into the Agricultural Trade bill.

The plan was opposed by the Agriculture and Commerce Departments. And when senators from the mining and industrial areas realized its import it was quickly killed.

The provision purported to cover only products of which we do not produce enough for ourselves. But it was so written as to cover practically anything which is imported in substantial volume.

The "certain" inclusion of oil in the list of products to be taken was pointed out by Sen. George D. Aiken (R Vt.). Other senators looked for and found a number of other products also imported to the detriment of domestic producers.

● Excessive oil imports are costly

FOR THOSE WHO wonder what excessive crude imports cost the country, Texas Gov. Price Daniel has some answers.

The excess of imports over their 1954 relation to domestic demand has cost our producers $759 million in the past 4 years, he says.

The people from whom oil companies and oil workers buy have lost additional millions.

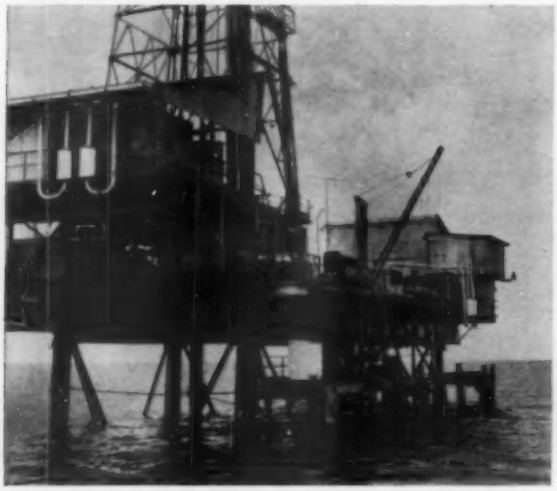
The oil states have suffered heavy cuts in revenue. Unemployment compensation funds have been drained.

And the federal government is losing hundreds of millions as income goes down and tax collections fall off.

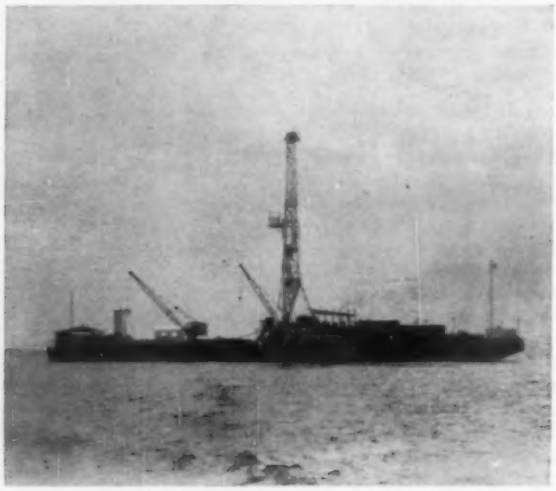
It all adds up to a big chunk taken out of the gross national product.

The oil industry had a recession long before the country as a whole. Its troubles merely became more acute as the economy slowed down.

Daniel says the oil situation was a big factor in starting the tailspin. He could well be right.



PERMANENT PLATFORM shown above in the Soldado area is one approach to drilling being used by oil companies in the Gulf of Paria.



FLOATING BARGE like this one drilling Couva Marine 1 off Trinidad offers another technique to operators in the open gulf waters.

Paria Gulf Drilling Features Variety

A DOZEN OIL companies are using just about every drilling tool in the book trying to develop a new offshore producing area in a region that is almost an inland sea—the Gulf of Paria.

The effort is about equally divided between the portion of the gulf controlled by Venezuela and the waters on the Trinidad side of the boundary.

So far, the old standard fixed platform has furnished the region with its only commercial production. But the newest wrinkle in marine drilling is being used by one company drilling from a floating barge. And, a German-built submersible drilling barge is headed for Paria.

The producers . . . The real old-timers in the area are the only ones so far to boast of commercial production.

Trinidad Northern Areas, Ltd., a three-company combine, is now producing about 2,000 bbl. daily from three wells drilled from a fixed platform.

TNA, owned by British Petroleum Co., Trinidad Shell, and Trinidad Oil Co. (now Texaco Trinidad, Inc.), spudded its first well in mid-1954. Two more deviated holes were drilled from this platform before the rig was moved off and the unit converted to a production platform. The wells produce from the Miocene, between 4,400 and 4,800 ft.

TNA spent almost $2 million on geophysical surveys and equipment before the first well was spudded. The 100 by 50-ft. platform was spotted a little more than 14 miles west of Trinidad's Point Fortin jetty lights and 7½ miles east of the international boundary between Trinidad and Venezuela in the gulf.

The company is building a second platform for a similar drilling operation.

Across the line . . . On the Venezuelan side of the boundary line a five-company combine is drilling the first of three tests on new concessions granted by Venezuela last year.

The five paid Venezuela around $102 million for the area now held by Paria Operations, Inc. Two more companies operating independently paid another $10 million in bonuses for two more tracts in the same area.

Like the Soldado wells, the first test by Paria Operations is being drilled from a permanent platform in about 80 ft. of water. The initial well has been the subject of some of the wildest rumors to come out of the Caribbean area, largely because the five owners have tagged it a "tight hole" and will release no facts about the test.

Reports from Venezuela indicate that Posa 112-1 has caused more than a little trouble. The well almost blew out several times between 3,000 and 4,000 ft., but was kept under control.

Various individuals associated with the owner companies concede that the well has encountered encouraging shows, but privately they add that the shows are so far not good enough to make the well commercial in view of the investment involved.

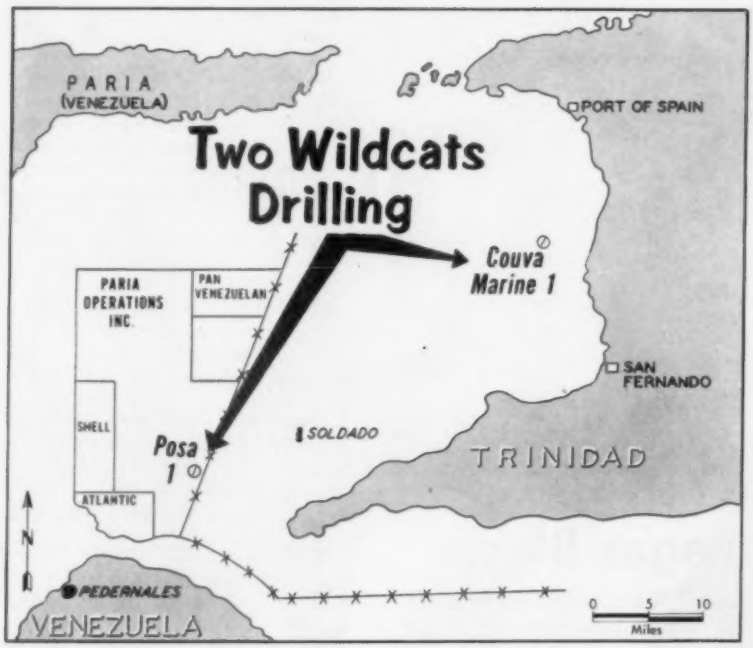
The test, served by a Loffland Bros. drilling tender, is just a mile west of the marine boundary and less than 10 miles from the Soldado wells. It is about 10 miles north of the Pedernales field on the Venezuelan mainland.

The owners of Paria Operations are Continental Oil Co., The Texas Co., and Ohio Oil Co., each owning 25%; Cities Service Co., with 16⅔%; and Richfield Oil Corp., with 8⅓%.

The floating barge . . . Back on the Trinidad side of the boundary and about 45 miles to the northeast, Dominion Oil Co., Ltd., a subsidiary of Standard Oil Co. of California, is using the newest technique in marine drilling (photo).

Dominion has a medium-depth well going down off the coast of Trinidad from a floating barge similar to those used off the west coast of the United States in core-drilling operations (OGJ, Oct. 7, 1957, p. 100).

Socal officials have shied away from calling this a wildcat. They refer to it as a stratigraphic test. But, the



barge is equipped with a National 55-A rig capable of going to 8,000 ft.

This test, Couva Marine 1, was drilled to 7,070 ft. before it encountered hole trouble that called for sidetracking. The crew lost the mandril in the hole at 5,500 ft. The bit was well below this depth in its sidetracked hole at the last official report of the well more than a month ago. The barge is anchored in 40 ft. of water 4½ miles off the west coast of Trinidad about 13 miles south of Port of Spain.

Submersible barge . . . The second submersible-type drilling barge built in Germany is now being towed across the Atlantic to the Gulf of Paria where it will be used by Trinidad Northern Areas.

The 2,200-ton barge was launched in January at the Gutehoffnungshuette shipyard at Blexen near Nordenham. Similar to the Adma Enterprise, which is drilling a test in the Persian Gulf, the new barge is equipped with four 164-ft. retractable legs which end in pontoons to be bottomed on the ocean floor for stability.

The companies involved may never make a major producing area out of Paria, but they won't be accused of not spending money or neglecting any known technique of marine drilling in their effort to do so.

Argentine Officials Quit Over Oil Policy

TWO ARGENTINE cabinet ministers have resigned in a new political clash over the country's oil policy.

The flareup was caused by a recommendation by a third minister that private foreign capital be permitted to help develop the industry. Dr. Julio Casar Cueto Rua, minister of commerce and industry, made the recommendation with the approval of Provisional President Pedro Eugenio Aramburu and the powerful military junta.

Two foes of foreign investments immediately turned in resignations. They are Dr. Carlos Alconado Aramburu, minister of the interior, and Dr. Acdeel Ernesto Salas, minister of education. Dr. Alconado Aramburu is no relation to the president.

The plan favored by the provisional government was worked out by the Argentine ambassador to Washington, Mauricio Yadarola. It is a modification of the standard 50-50 concession contract.

Under it, companies would develop oil production at their own risk under contract with the state agency, Yacimientos Petroliferos Fiscales (YPF). They would be paid with a part of the oil produced.

The plan was an attempt by the provisional government to solve the worsening oil problem. Argentina now spends $300 million per year for oil imports. Its annual trade deficit is more than $200 million.

Domestic production has risen to about 100,000 bbl. daily, most of it produced by YPF. But demand is outstripping production, and the country does not have enough money available to improve the situation. Production by private companies is declining, and no new concessions have been granted for years.

The Yadarola plan appears doomed. The winner of the recent general election, President Elect Arturo Frondizi, of the Intransigent Radicals, condemned the plan from the start.

Frondizi has hinted that foreign money would be welcomed in the present framework of YPF operations. But even a plan to bring in money on a more limited basis than under the Yadarola proposal would probably face a fight.

Venezuelan Test Completed

PANCOASTAL PETROLEUM Co. and Venezuelan Atlantic Refining Co. have completed a discovery on their 6,200-acre Pirital concession in the Punto Gordo area in eastern Venezuela.

The Pirital 6 was placed on pump with an output of 240 bbl. daily of 19°-gravity crude. Production is from perforations from 1,210-80 ft. A feeder line is being built to nearby pipeline facilities.

Pancoastal and Atlantic also have completed the fifth producer in their new jointly-owner Aguasay-Caro field. Caro 3 was completed as a dual producer with a flow of about 1,000 bbl. daily.

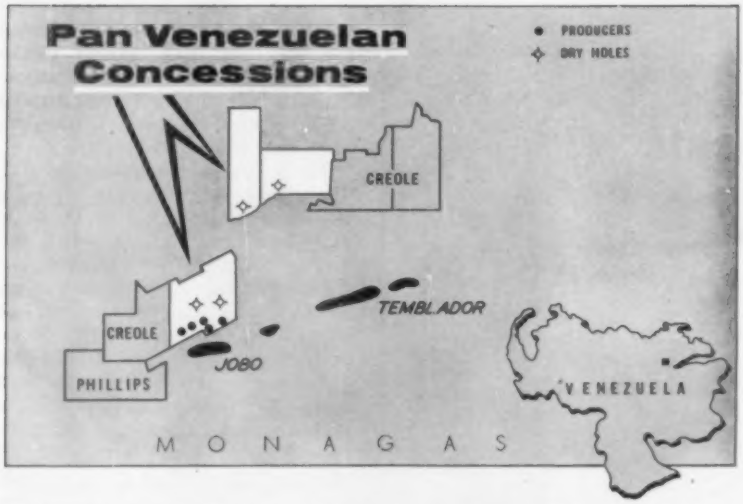
The five Caro wells so far completed average a total of about 5,000 bbl. daily of 35°-gravity crude. Two more development wells, Caro 5 and 7, are drilling below 11,500 ft. The producing zones are between 12,000 and 13,800 ft. Venezuelan Atlantic is the operator.

Pemex, Now 20, Optimistic

MEXICO'S ANNUAL celebration of oil nationalization has served as a reminder that 20 years have past since foreign oil properties were expropriated, one of the earth-shaking events in the history of the industry.

This year's observance showed a definite settling down from earlier days when the ceremonies were a time of nationalistic and leftist demonstrations. In contrast, the report of Antonio Bermudez, director general of Petroleo Mexicanos, had praise for United States bankers and equipment suppliers.

He said production is now averaging 272,000 bbl. daily, and proved reserves are at an all-time high of 3,373,000,000 bbl. Fourteen fields were discovered last year.



Dusters Dot Monagas Blocks

ALL NEW CONCESSIONS in Venezuela have not turned out to be as promising as Lake Maracaibo acreage.

Pan Venezuelan Oil Co., a subsidiary of Standard Oil Co. (Ind.), has released two rigs drilling in southern Monagas. The company is now re-evaluating its properties. Four dry holes have been drilled since November.

Two of the wildcats were located on Block 11, and one each on Blocks 28 and 30. The three concessions cover 70,800 acres, for which Pan Venezuelan paid more than $35 million.

The company had better luck with offsets to the shut-in Jobo field of Creole Petroleum Corp., located south of Block 11. The fifth Jobo offset is now being completed. The wells are expected to produce 8° to 12°-gravity crude.

In Barinas, Venezuelan Atlantic Refining Co. has abandoned Paez 1 at 9,358 ft. as a dry hole.

More Cars Force Kuwait to Add Reformer

KUWAIT OIL CO. is adding a UOP Platformer at its newly expanded Mina-al-Ahmadi refinery.

The special process unit will upgrade gasoline marketed within the shaikhdom. It also will take out of the export trade at least a small part of the refinery's straightrun gasoline.

Kuwait's newly enlarged refinery was officially opened this month when two new 80,000-bbl. pipe stills were dedicated at the 30,000-bbl. refinery (OGJ, Mar. 24, p. 106).

The new catalytic reforming facilities will consist of three main parts. There will be a prefractionation plant that will treat 7,000 bbl. of straight-run gasoline to produce 4,000 bbl. daily of naphtha charge stock, a 4,000-bbl. Hydrobon catalytic desulfurization unit, designed by UOP, and the Platformer.

A growing demand for high-octane gasoline in Kuwait prompted plans for the new unit. The number of cars in the rich little country has increased from 1,000 to 20,000 in the past 10 years. There is now one vehicle for every 10 inhabitants.

The average life of an automobile engine under Kuwait's climatic conditions is much shorter than in the U. S. This helps make the percentage of new cars requiring high octanes very high.

Algerian Permits Sought

TWO COMPANIES held jointly by the French and Royal Dutch-Shell have applied for extensions on several Algerian permits due to expire in May.

The permits include the license covering Edjele and Tiguentourine fields and the Zarzaitine discovery located near the Libyan border. Under the terms of 5-year permits issued in 1953, Cie. de Recherches et d'Exploitation de Petrole au Sahara (CREPS), is due to surrender half of this and other acreage in the Sahara.

Cie. des Petroles d'Algerie (CPA), in which Shell has 65 per cent interest, is due to give up half of its acreage on licenses in the Central Sahara.

Deadline for other companies bidding on the permits is April 12.

World briefs

Bolivian Gulf Oil Co. is below 3,000 ft. in its first wildcat on the company's big concession in southern Bolivia. The 1 Mandeyapecua, about 18 miles east of Boyuide and 90 miles north of the Argentine border, is scheduled to go to 13,500 ft. The wildcat is about 50 miles southeast of Camiri, Bolivia's main producing field.

Bolivian Gulf is owned by Gulf Oil Corp., Falcon Seaboard Drilling Co., Williams Brothers Sudamericana, Ltd., and Barry & Reiner, Inc.

Communist China says the biggest discovery in the country's history has been made in Central Szechwan. The province is in Central China, east of the main areas of exploration.

Work on a new 30,000-bbl. refinery at Emden, West Germany, will start within 2 months if the government approves the project. Erdoelwerke Frisia, A.G., set up by Gottlieb Duttweiler, a Swiss financier, expects to have the plant on stream by the end of 1959. The capacity will be doubled in 1961.

A Japanese firm has signed a contract for the first purchase of Russian crude since World War II.

Tokyo Boeki Co. will buy one cargo at $15 per ton, or about $2.05 per barrel, f.o.b. Baku. The crude reportedly will be paid for in rolled steel.

A newly formed French company plans to lease Russian turbodrills to operators in France. The company will service the equipment used by its customers with the help of Soviet experts.

The Shah of Iran has inaugurated the new 600-mile, 10-in. products pipeline from Abadan refinery to Teheran. The initial capacity is 20,000 bbl. daily. This will be doubled later.

Creole Petroleum Corp. has announced price reductions of 5 to 15 cents a barrel in several of its heavier crude-oil quotations. Reductions range from 5 cents for 21° API Motatan to 15 cents for the asphalt and other low-gravity crudes. The change follows a similar price reduction on February 12 by Shell Oil Co.

Japan will step up crude imports to 292,000 bbl. daily this year if its plans are not snagged by foreign-exchange troubles. An 18% increase is the goal, but currency allocations for crude are nearly exhausted.

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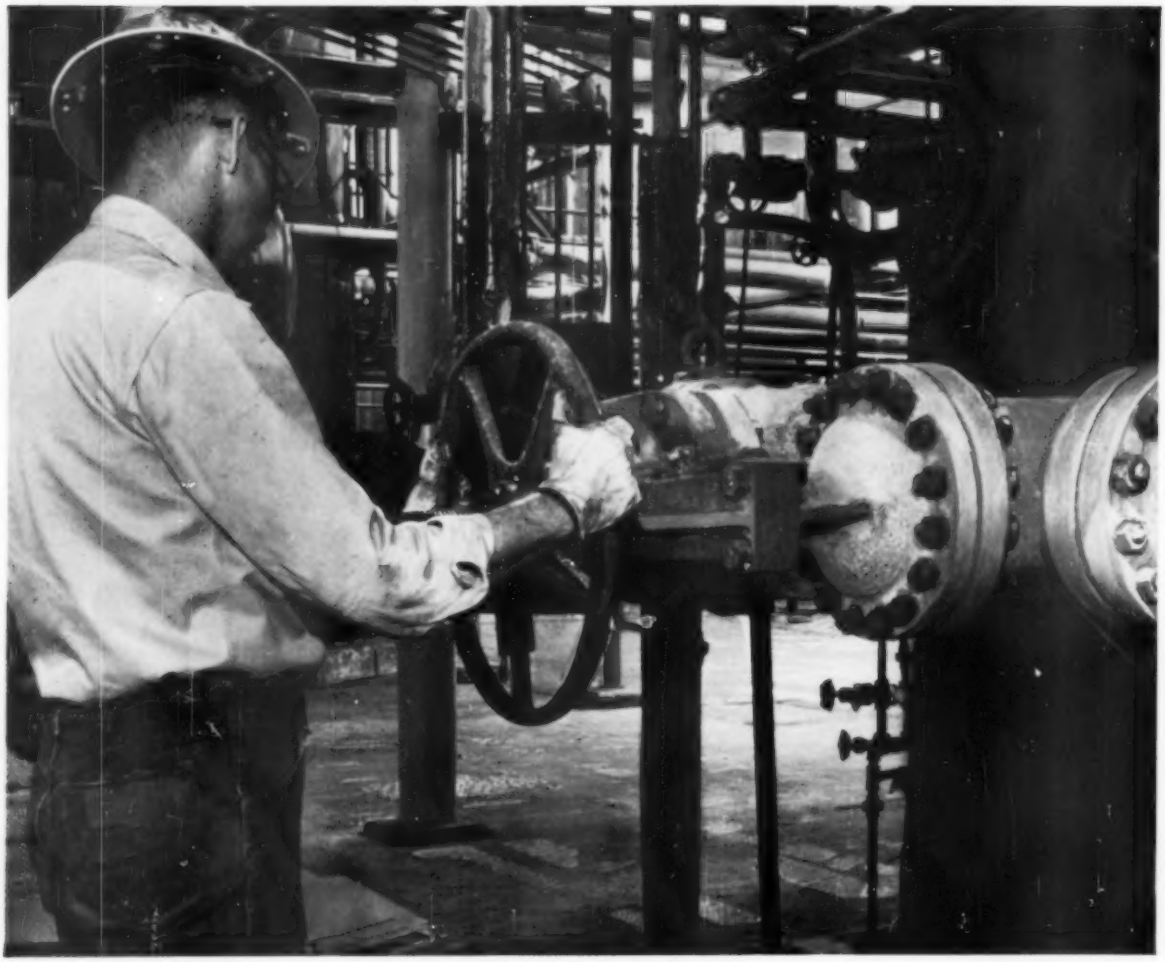
THE EYES OF THE OIL INDUSTRY®

SCHLUMBERGER

Another refinery knows Crane steel valve durability



How to insure steady control of hot oil for seventeen years plus

There's no guesswork in this refinery's hot-oil valving. Quality comes first and foremost in its valve buying.

The block valve shown being operated on Continental Oil Co.'s thermal cracking unit at Lake Charles, La., was installed in 1941. Working at 830 deg. F., this Crane 8-inch, 300-pound steel gate has never been out of the line for repair.

Except for routine lubrication and repacking when needed on turn-arounds, maintenance through the past 17 years has been of a very minor nature. Still this Crane valve is leak-free, completely dependable, operates with ease.

On steel valves—on all valves and fittings for refinery needs—Crane is the name that assures real, long-term values and protects against unreal price-tag savings.

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Introducing: Alkar and Butamer

. . . to the growing list of refining processes designed to meet today's demand for improved products

BY H. W. GROTE
Universal Oil Products Co.

TWO NEW PROCESSES have been developed by Universal Oil Products Co.

1. The Butamer process promises to fill the need for efficient and economical conversion of normal butane to isobutane with a minimum capital investment. This process will thus help satisfy the increasing demand for isobutane as a component of alkylation plant feed stock, which demand will become apparent with increasing use of alkylate for blending into motor fuels.

2. The Alkar process permits, on a scale heretofore impractical, the utilization of the light olefin content of the refiners' fuel gas. Instead of burning these byproducts, they now may be converted into valuable petrochemicals. The quality of Alkar ethylbenzene and cumene is exceptionally good, these products meeting the exacting demands as chemical raw materials for further conversion.

Isobutane valuable . . . One of the trends that has been notable in our industry is the increased use of individually synthesized or separated hydrocarbons for compounding of extra-high-octane quality fuels. This has placed a premium value on isobutane for alkylation-plant feed, isopentane and isohexanes for selective gasoline blending, and alkylate and concentrated aromatic fractions for superpremium fuels.

There has been a reduction in the demand for military aviation gasoline, which has released some alkylate capacity for motor fuels. In addition to this, we have seen a very substantial increase in new alkylation-plant capacity during the past year, with even more being scheduled for erection during 1958. The increasing output of alkylate, now over 300,000 bbl. per stream day, requires ever-increasing quantities of isobutane.

As a result, isobutane is becoming in short supply and refiners are once more turning to butane isomerization installations to satisfy the needs of their alkylation units, as was first done on a large scale during World War II.

The isomerization processes in use in the early forties have certain definite limitations when judged by today's standards.

We have directed considerable effort towards an improved normal butane isomerization technique to meet the needs of alkylation plant operators. The new Butamer process has thus been developed for economical isomerization of normal butane.

Petrochem aid . . . Another refining industry trend which has become well established is the diversion of specially synthesized or separated hydrocarbons from the normal line of refinery products to satisfy certain raw material needs of chemical manufacturers.

The manufacture of individual hydrocarbons and special hydrocarbon mixtures as raw material for the ever-expanding "petrochemical industry" offers the refiner an opportunity for diversification. He can, in this manner, place a rather small but nonetheless important proportion of his total output into new markets. These new markets are not so completely dependent on the nation's appetite for fuels as have been his traditional product outlets.

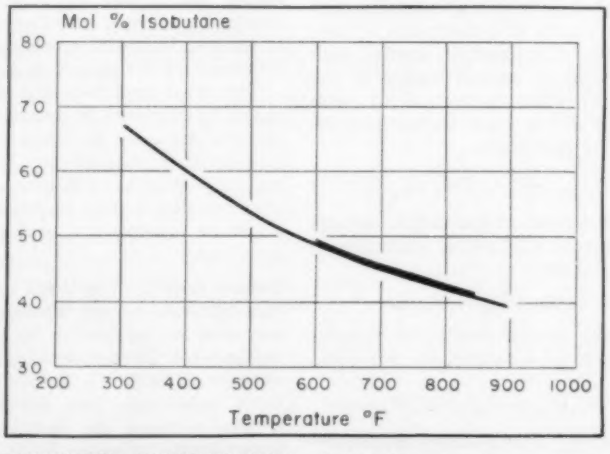
In the past it has been difficult for many refiners to enter this field in an effective manner, due to the large scale of operation required to obtain an economic plant, with consequently large demands on feed stocks and investments.

Alkar, a new petrochemical-manufacturing process, is useful in all sizes of refineries for the manufacture of a variety of alkylated aromatics.

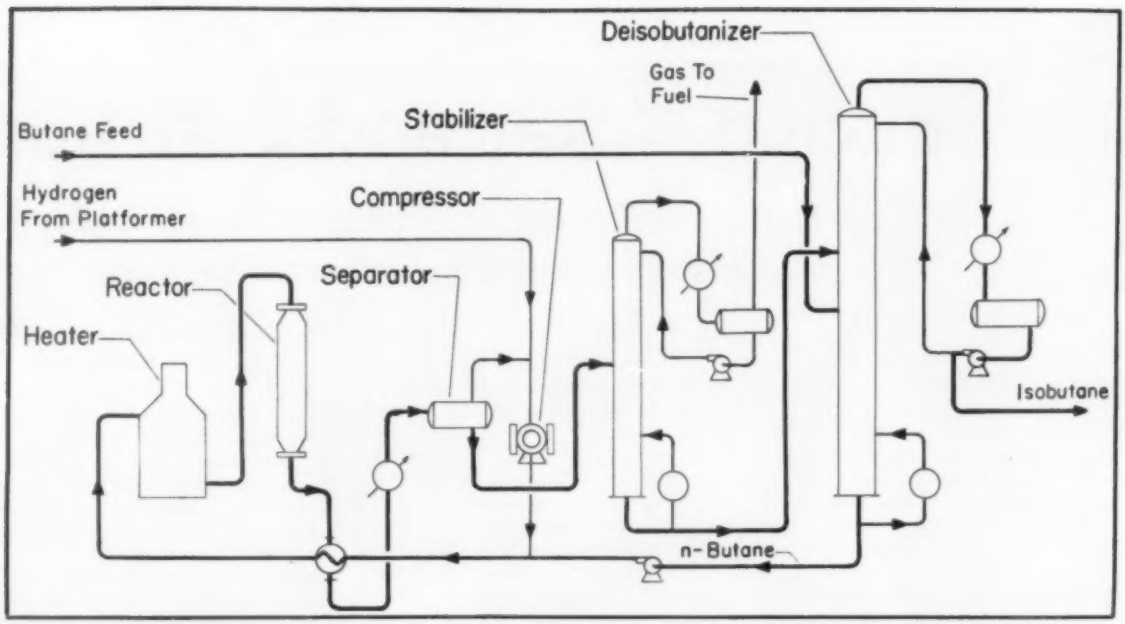
The Butamer Process

In our work on a new process for the conversion of normal butane to isobutane, our primary objective was the development of a stable and rugged catalyst capable of operating at relatively low temperatures. The low operating temperature was desired so that the concentration of isobutane in the effluent from the reactor would be sufficiently high to eliminate an excessive amount of recycle of normal butane.

This objective has been attained by use of a specially prepared platinum-containing catalyst. As can be seen from Fig. 1 which is based on data obtained with the Butamer catalyst,



EQUILIBRIUM CONCENTRATION of isobutane in the range to 600° to 850° F. ranges from 49 down to 40% when operating with the new Butamer catalyst. Fig. 1.



BUTAMER PROCESS FLOW provides for feed preparation, isomerization in hydrogen atmosphere, and fractionation to remove product isobutane from recycle normal butane. Fig. 2.

temperatures in the range of 600° to 850° F. will produce an equilibrium concentration of isobutane in the total butane effluent ranging from about 49 to 40%. The process is operated under hydrogen pressure.

Because of the low molecular weight of the charge stock, the tendency to form carbon on the catalyst is considerably lower than in reforming of straightrun gasolines and naphthas. A lower hydrogen-to-charge ratio is utilized. The high activity of the catalyst makes it possible to operate the process at economical liquid hourly space velocities, thus providing for a reasonable catalyst inventory.

Yields . . . The proper combination of catalyst activity and operating conditions results in a minimum of side reactions. For example, starting with 100 moles of normal butane in the feed, 0.7 mole is reacted to form methane and propane as shown by the following equation:

$$C_4H_{10}+H_2 \rightarrow CH_4+C_3H_8$$

while 0.4 mole of the original charge is converted into ethane according to this equation:

$$C_4H_{10}+H_2 \rightarrow 2C_2H_6$$

0.8 mole is converted into propane and pentanes as shown by this equation:

$$2C_4H_{10} \rightarrow C_3H_8+C_5H_{12}$$

and, finally, 39.6 moles of the normal charge are converted to isobutane:

$$nC_4H_{10} \rightarrow iC_4H_{10}$$

Of the original 100 moles of normal butane, 58.5 moles are unconverted and can be recycled for further conversion. The over-all molar efficiency of this operation is 39.6/(100−58.5) = 95.4%.

If one takes credit for the production of pentane, which mixture incidentally consists mostly of isopentane, and computes the conversion on a volumetric basis starting with 100 volumes of normal butane, the ultimate yield from this Butamer operation is 100.3 vol. %, 99.0 volumes being isobutane and 1.3 volumes being pentanes.

It is interesting to note that the same product distribution is obtained during the course of a long run, amounting to many barrels per pound of catalyst, indicating no change in the efficiency of the operation.

The usual impurities that one may expect to encounter in commercial operations act only as temporary suppressors of catalyst activity. The process design may be readily arranged to eliminate any of these materials which might be present in a particular butane feed.

Process flow . . . Fig. 2 is a schematic flow diagram of the Butamer process. The butane feed is fed to a deisobutanizer. The deisobutanizer serves to recover isobutane in the feed, as when processing field butanes, and it also recovers the isobutane produced by the process.

Continuing with the process flow diagram, the reactor feed is withdrawn from the deisobutanizer, mixed with recycle gas, heated, and passed to a single reactor. Reactor effluent is cooled, the recycle gas separated from the product liquid, and the liquid stabilized to remove dissolved gas.

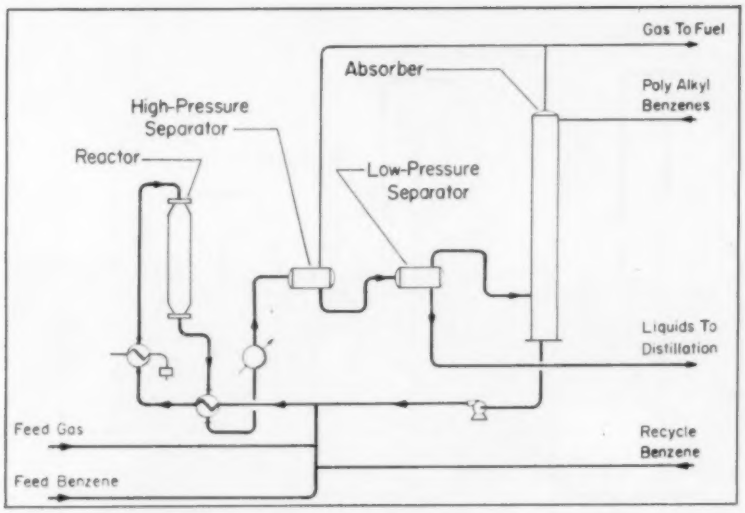
This dissolved gas includes both the paraffins introduced with the hydrogen makeup stream, and also the net production of light paraffins. The stabilizer bottoms stream is fed to the deisobutanizer for recovery of the isobutane product and for recycle of unconverted normal butane.

Some of the economic factors involved in the production of isobutane by means of the Butamer process are tabulated in Table 1.

The capital investment varies with size from $800 down to $400 per daily barrel of isobutane for plants in the

THE AUTHOR

Henry W. Grote is manager of the petrochemical process sales department, Universal Oil Products Co. He joined UOP after receiving his degree in chemical engineering from University of Michigan in 1938. He has been manager of Universal's pilot-plant division and assistant manager of research laboratories. Grote is a member of Sigma Xi, Tau Beta Pi, American Chemical Society, and American Institute of Chemical Engineers. This paper was presented at the WPRA meeting, San Antonio.



ALKAR PROCESS FLOW provides for the alkylation of light olefins with benzene, two-stage separation of reactor effluent, and absorption of unreacted benzene vapors from the off gas. Fig. 3.

TABLE 1—BUTAMER PROCESS ECONOMICS
(Gulf Coast Basis)

Process investment, per daily bbl. iC_4	$800-400
Operating costs, cents per gallon iC_4:	
Labor	0.35-0.15
Utilities	0.75-0.75
Catalyst	0.25-0.25
Maintenance, taxes, etc.	0.25-0.15
Totals	1.60-1.30

capacity range of interest to most alkylation-plant operators. Roughly one-third of this investment is represented by the deisobutanizer. Normally, however, an isomerization unit will be integrated into an alkylation unit—particularly if new construction is contemplated.

Thus the deisobutanizer may be sized, as a single column, to meet the requirements of **both** units. This results in the generation of a considerable credit for the combined over-all investment cost of the two units.

The direct operating costs for labor, utilities, catalyst, maintenance, and so forth total about 1.5 cents per gallon of isobutane made. The scale of operation here does not substantially affect direct costs, for those cost elements which change with plant size represent only 20 to 30% of the total direct costs.

On adding capital charges to allow a reasonable payout rate on the investment, the total cost of producing isobutane from normal butane is about 3 cents per barrel for an average situation.

The Alkar Process

In considering the possibilities for additional manufacture of chemical raw materials from petroleum, we have looked at operations that may be useful to even the smallest refiner. One of the recovery operations practiced occasionally in very large refineries is the recovery of ethylene from cracked gas streams that otherwise would go directly to fuel.

The recovery of this byproduct olefin from offgas streams has been in the past considered impractical for many refiners, due to the very substantial investments required for separation equipment, and therefore has not been widely practiced.

Ethylene is available in such offgas streams in reasonably large quantities, perhaps 1½ billion pounds a year being burned as fuel in refineries in the United States. As the ethylene is available at the very low concentration level of 8-10%, it was reasoned that real economies might result if the byproduct olefin could be chemically converted without the necessity of prior concentration.

Development of such a conversion technique has the promise of permitting further entry of refiners into the petrochemical field. We are pleased that our research and development groups have come up with an elegant solution to the problem.

Complete reaction of low-concentration, byproduct olefins is achieved with aromatics such as benzene, even though the olefin may be present at the very low concentrations normally encountered in cat cracker absorber-gas streams.

New catalyst . . . This development, of tremendous significance to refiners everywhere, is based upon the use of a completely new catalyst. This catalyst, in solid form, is used as a fixed bed in reactors of conventional design. Because the catalyst is noncorrosive, the use of expensive alloys in reactor construction is unnecessary.

The catalyst is stable against conditions normally encountered in processing, as well as in the handling required in loading the reactors. The Alkar process uses this catalyst in such a way that catalyst costs are low, and special catalyst-handling equipment is at a minimum.

In the operation of the process, conversion of all olefins contained in the feed gas is normally complete; that is, no detectable traces of olefins are found by analysis of the processed gas. All olefins present are converted to alkyl aromatics, primarily of the monoalkylated type; that is, ethylene to ethylbenzene, propylene to cumene, and butylenes to butylbenzenes.

Some production of dialkylated and polyalkylated aromatics also is encountered. As, with this catalyst system, these higher alkyl aromatics will react with benzene to form the corresponding monoalkylated compounds, high efficiencies of olefin usage can be obtained using recycle of polyalkyl aromatics to the reactor. Molecular conversion efficiencies of ethylene and propylene are both of the order of 90% to monoalkyl benzenes. Molecular conversion efficiency of benzene to monoalkylated products is substantially higher.

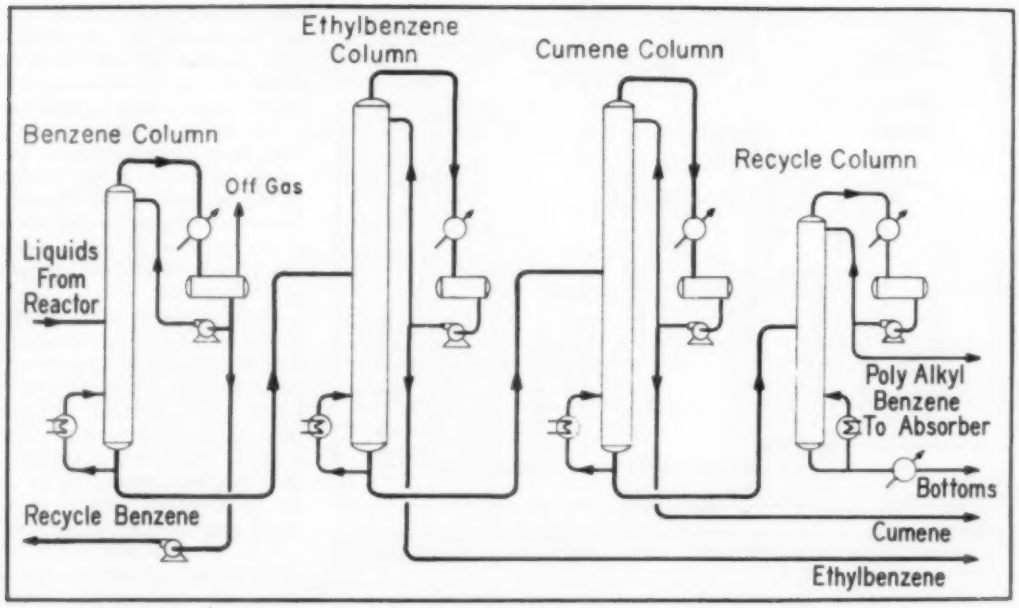
Relatively few problems were encountered in translating laboratory and pilot-scale experimental data to the initial commercial designs.

The compositions of typical deethanizer gas streams were studied to determine if the characteristic nonhydrocarbon impurities would cause difficulties. Three such analyses are shown in Table 2. These gases, as removed from the deethanizer, contained

TABLE 2—FUEL GASES FROM CATALYTIC CRACKING

	Compositions, mole %*		
Oxygen	0.1	0.4	0.1
Nitrogen	21.4	27.5	29.8
Carbon monoxide	5.9	4.4	5.7
Hydrogen	7.9	12.3	9.9
Methane	30.1	24.5	26.5
Ethylene	11.8	9.2	9.9
Ethane	13.8	15.7	14.0
Propylene	4.8	2.6	1.9
Propane	1.7	1.5	0.3
Butanes-butylenes	1.7	1.7	1.6
C_5+ Hydrocarbons	0.8	0.2	0.3

*After removal of H_2S and CO_2, dry basis.



ALKAR FRACTIONATION EQUIPMENT provides for recovery of pure product streams of ethylbenzene, cumene, and polyalkylbenzene. Fig. 4.

2 to 10% hydrogen sulfide and 5 to 6% carbon dioxide.

While it was early determined that oxygen and carbon oxides had no effect on the reaction efficiency or catalyst activities, pretreatment to remove other impurities, such as hydrogen sulfide, is desirable. Materials of construction throughout the entire plant are standard, the vessels and piping being almost entirely fabricated of carbon steel.

Process flow . . . Fig. 3 shows a schematic flow diagram of the reaction section. The reactor operates at low temperature levels, hence can conveniently be heated by steam. The reaction is exothermic, and in certain cases the preheater can be shut down after startup, relying on heat exchange for reactor feed preheat. Feed gas is compressed into the reactor along with fresh and recycle benzene.

Polyalkylbenzenes are returned to the reactor by using them first as absorber lean oil. The absorber has the function of recovering benzene that would otherwise be lost with the gas to fuel.

The reactor effluent is flashed, first at reactor pressure to vent the bulk of the residue gas with minimum benzene loss, and then at the absorber pressure to "degas" the liquid products as far as is practical prior to distillation. The low-pressure flash gas is processed in the absorber to recover benzene.

Fig. 4 gives a process flow diagram of the Alkar fractionation section. It is a complex of fractionation equipment and represents a major part of the total Alkar plant investment.

TABLE 3—ALKAR PROCESS RESULTS

Feeds:	
Benzene, bbl. stream day	200
Absorber gas:	
Ethylene, s.c.f.d.	306,000
Propylene, s.c.f.d.	33,000
Total gas feed, s.c.f.d.	3,000,000
Products:	
Ethylbenzene, bbl. stream day	240
Cumene	27
Recycle column bottoms, bbl. stream day	12
Gas to fuel, s.c.f.d.	2,661,000

TABLE 4—ALKAR PROCESS INVESTMENT AND UTILITIES

Process equipment:	
Estimated erected cost	$1,100,000
Estimated utilities:	
Fuel gas, s.c.f.d.	550,000
Cooling water, g.p.m.	1,100
Electric power, kw.	180

The first column separates unconverted benzene for recycle to the reactor. The next column removes, as an overhead distillate, the ethylbenzene product.

Similarly, the cumene column, the next fractionator in the sequence, produces a cumene product having a purity suitable for conversion to phenol and acetone.

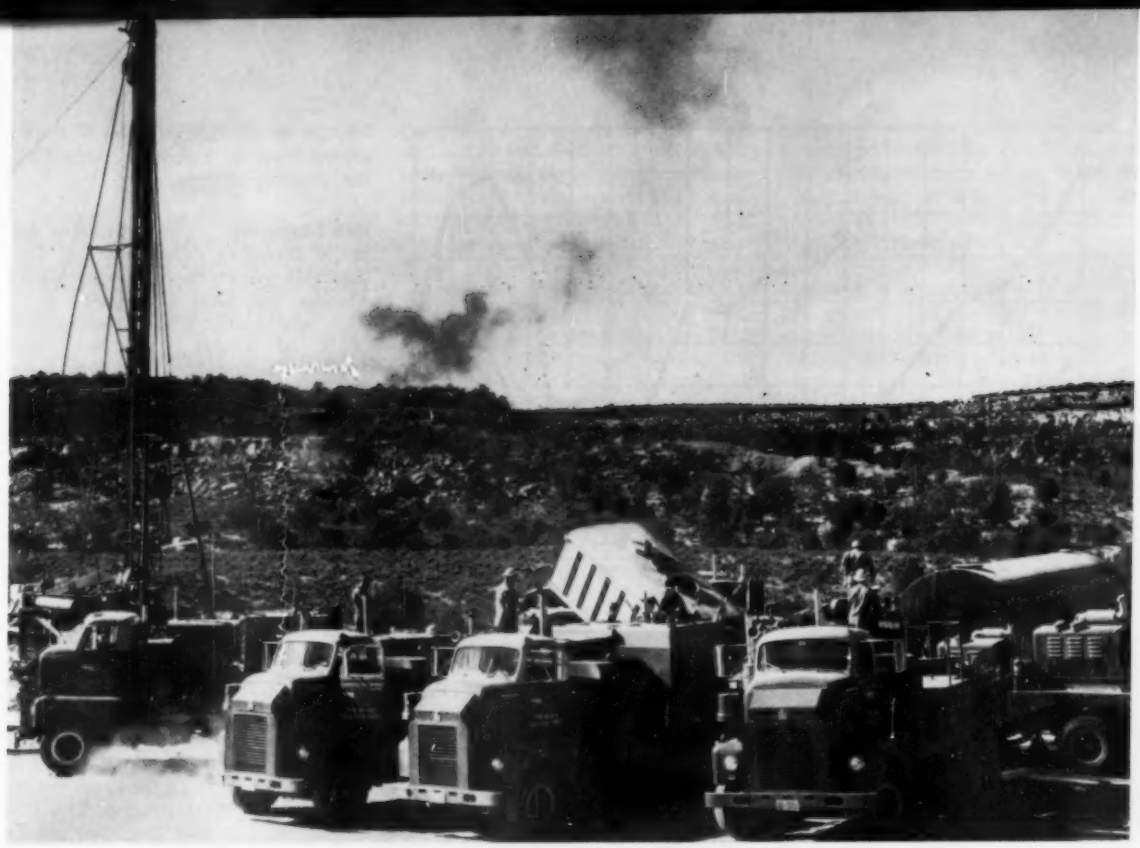
Recycle . . . The polyalkylbenzenes formed in the reaction, while of appropriate boiling range for inclusion in motor gasoline, are most advantageously returned to the reaction zone for further conversion, with benzene, to yield additional quantities of monoalkylated products. A small column is provided so that these polyalkylated materials may be recycled as a distillate. A very minor quantity of heavy bottoms is periodically drawn from the base of this column.

The Alkar process may be applied to a variety of feed stocks. Table 3 shows typical yields of ethylbenzene and cumene from Alkar processing of the absorber gas from a small catalytic cracking plant. This unit is equipped with an efficient LPG recovery system, hence the propylene content of the Alkar feed gas is unusually low.

Table 4 gives the investment and utilities requirements for this plant. The total process investment of $1,100,000 does not include the necessary tankage and utilities systems. Fuel gas is required for a reboiler oil heater. No steam is required except for startup and the cooling water.

Depending on local refinery factors and on price structures for benzene, ethylbenzene and cumene, the payout will, of course, vary somewhat. In the case of the plant just discussed, using 36-cent per gallon benzene, fuel gas value feed olefins, 8-cent per pound ethylbenzene, and 6-cent per pound cumene, the capital investment in process equipment is returned, after taxes, in about 3 years.

Another potential application of the Alkar process, which shows future commercial promise, achieves upgrading of fuel gas value olefins to premium octane motor fuel. This is accomplished by the use of the Alkar technique to react these olefins with aromatics produced by catalytic reforming.



Fracturing, as here in the San Juan basin, is one of the . . .

Stimulation techniques that enable gas production to keep up with growing demand

Explosives, acidizing, hydraulic fracturing, and special chemicals are each effective in specific areas

BY A. B. WATERS, FRANK N. LISCUM, and HUGH J. AYRES
Halliburton Oil Well Cementing Co.

DEMAND for natural gas has been continually increasing. In 1956 approximately 10,000 billion cubic feet was delivered to about 27 million customers, a delivery 7% higher than 1955. Estimates of 1957 production were up an additional 6%. At the end of September 1957, gas accounted for nearly 34% of the petroleum market.[1]

Much of this increase in gas production can be attributed to the application of special stimulation techniques. These procedures may be classified into four general categories:

1. Explosives
2. Acidizing
3. Hydraulic fracturing
4. Special chemical treatments

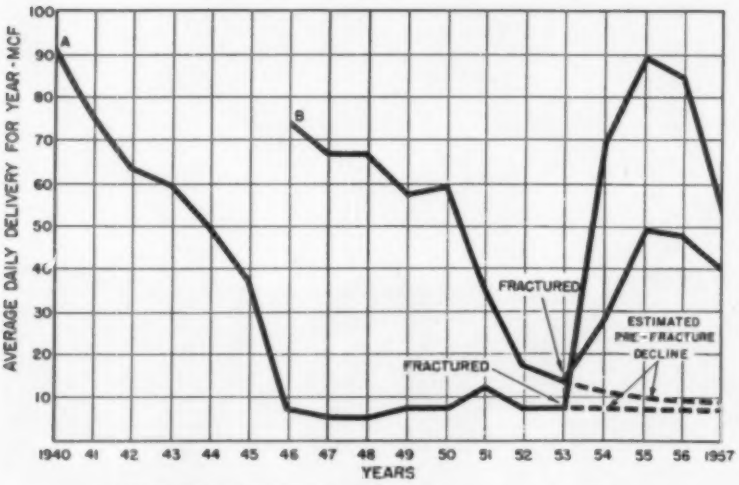
Explosives

Well shooting . . . The earliest widely accepted technique for well stimulation was the detonation of explosives opposite competent producing formations. Although very little was known about formation plugging resulting from drilling techniques, it was recognized that well stimulation was desirable and that, under similar conditions, a larger well bore was more productive than a smaller one. This was actually a matter of surface area exposed. Explosives were used to enlarge the well bore and create an extensive network of fractures in the immediate vicinity of the well bore, thus leading to increased production.

Placement and detonation techniques varied widely. Normally the casing was set some distance above the producing zone to avoid damage to the casing. The explosive might be detonated with or without fluid in the hole while at other times a plug of cementing material placed on top of the charge confined its force.

Inherent hazards to both personnel and equipment were involved in the use of certain types of explosives. More recent developments have minimized the risk in this process without decreasing its effectiveness.

Some economic disadvantages associated with the use of explosives as



RESULTS OF FRACTURING two old Clinton gas wells. Fig. 1.

a stimulant were the long and expensive clean-up periods often necessary to remove cavings and debris from the producing formation and from the nonproductive zone above in addition to the occasionally damaged casing. Remedial work at a later date often presented many difficulties due to the well-bore condition as a result of the shot.[2]

In some areas, explosives are still used as a stimulation procedure. The Clinton formation of Ohio, which is a Silurian age coarse-grain sand laminated with lenticular shale beds, is an example. From one to three sections averaging 10 to 15 ft. thick may be present with an average permeability of 18 to 25 md. and 15 to 18% porosity. A typical well may have natural production up to 1,000 M.c.f. and a bottom-hole pressure of 500 psi. Stimulation with explosives generally increases production one or twofold with a good production-decline curve. Fracturing one of these wells usually results in a production increase of approximately six times initial production.[3] See Table 1.

TABLE 1—TYPICAL WELL STIMULATION RESULTS—CLINTON GAS FORMATION

Fracturing

Initial open flow (M.c.f.)	Open flow after stimulation (M.c.f.)	Increase (M.c.f.)
133	1,000	867
357	1,330	973
73	214	141
43	1,580	1,537
61	513	452
667	4,637	3,970

Explosives

Initial open flow (M.c.f.)	Open flow after stimulation (M.c.f.)	Increase (M.c.f.)
60	104	44
35	60	25
330	800	470
524	594	70
291	563	272
1,240	2,121	881

Acidizing

Next major development in the field of well stimulation was the use of hydrochloric acid which rapidly became a major production-improvement technique for gas wells producing from carbonate reservoirs. Starting with the crude procedure of dumping acid on a producing zone, many modifications and improvements such as inhibitors, surface-tension-reducing agents and nonemulsifiers were introduced to increase treating efficiency and adaptability to a variety of conditions. At the same time the total volume used per well became much greater. All of this resulted in a corresponding improvement in gas production.

Treating techniques are varied depending upon the peculiarities and problems encountered in different areas and formations. In some dolomite reservoirs such as Hugoton field (Kansas), there was evidence that fine undissolved particles were being released by the acid with resultant plugging of the permeability. Experimentation led to breaking the total volume of acid used into a number of smaller treatments with each successive treatment being larger than the last. By allowing ample time for flowback and cleanup between stages, a high percentage of the fine particles were removed from the formation minimizing the plugging effects.

Still important . . . Acid remains the major stimulant in some areas. The principal gas producing formation in Monroe gas field (Louisiana) is a 95% acid-soluble, slightly fossiliferous chalk of Upper Cretaceous age. Initially, bottom-hole pressures were very high but they have declined to about 50 to 250 psi. in a large portion of the field; however, at isolated places pressures still go as high as 400 psi. indicating nonconformity in the formation. Average deliverability on new wells is 100 to 150 M.c.f. After treating the more permeable formation (up to 500 md.) with 3,000 to 4,500 gal. of 15% nonemulsifying acid, deliverability generally increases 50 to 100%. Fracturing is used occasionally on the extremely low-permeability wells where acid does not give good results.

Gas production in Bethany-Longstreet field (East Texas) comes from the Crane member of the lower Pettet, a Cretaceous age formation. This formation is a slightly fractured oolitic limestone with an average permeability of 35 md., 18% porosity, 95% solubility, and a bottom-hole pressure of 3,200 psi. A customary treatment, employing 2,000 gal. of low-surface-tension acid followed by 8,000 gal. of nonemulsifying acid, results in open-flow potentials ranging from 40,000 to 80,000 M.c.f., a six to ten-fold increase. At the same time, deliverability increases to approximately 1,500 M.c.f. of gas at 1,800 psi. and 35 to 50 bbl. of distillate per M.M.c.f.

Types of acid . . . Emulsified acid frequently is used because of its retardation effect. The acid does not readily contact the formation because it is the internal phase of the emulsion, thus it penetrates farther before completely reacting. This procedure has been very successful on small producing wells in the Chester series of Southwest Kansas and the Texas-Oklahoma Panhandle. Such an emulsion also can be used as a diverting agent in connection with normal acidizing operations. By spotting it across previously treated zones, the regular acid is diverted into less permeable sections.

Special types and forms of acid are regularly used in conjunction with other stimulation techniques and are considered to fall under the classification of special chemical treatments. When used as a fracturing fluid, acid can be emulsified, gelled or nonthickened. Small quantities frequently are added to water base fracturing

fluids as a buffer and clay antiswelling agent.

Fracturing

In 1949, hydraulic fracturing became available as a production stimulant for oil and gas wells completed in either carbonate or sand-type formations. In this now well-known procedure, pressure transmitted through a sand-laden fluid to the producing interval parts the formation and continued pumping extends the fissure a distance from the well bore. Sand carried in the fluid acts as a propping agent to maintain the fracture for maximum flow capacity through it.

In reality, the effective diameter of the well bore is increased. Fracturing gained rapid acceptance and in many cases replaced other techniques because greater drainage areas generally are provided more economically, normally resulting in higher production increases associated with better declines.[4]

This procedure emphasizes the importance of proper or adequate isolation of the interval being treated, consequently more consideration is being given to casing, cementing, and completion procedures. A high percentage of the casing is set through the producing interval and selectively perforated, sometimes employing only one or two perforations per foot.[5,6,7]

Research and experience indicate no one fracturing fluid or technique is completely satisfactory for treating all formations, therefore several are available to choose from. Often, equal results are obtained with more than one type of fluid on a formation; however, economy, availability, operators' preference, and other factors enter into the choice of the ones currently being used in any particular area. All of these fluids can be classified in three general categories; (1) gels, (2) emulsions, and (3) true fluids.

Gels

Original conceptions of hydraulic fracturing indicated extremely viscous fluids were needed to transport the propping agent and to prevent entry into the natural permeability whereby fracturing pressures could be attained.

Gels met most of the requirements. The first fluid was a gelled hydrocarbon which consisted generally of kerosine as a base fluid to which a granular oil-soluble gelling agent and an internal breaker were added.

Possessing low-fluid-loss characteristics, good sand-carrying ability, and readily reverting to a low-viscosity fluid, it has the disadvantages of relatively high friction loss and cost.

Eastern U. S. . . . Early treatments consisted of small volumes of fluid and sand which were very effective on some formations while disappointing on others. As usage spread and volume of treatments increased, this gelled carrying agent was replaced in many cases with more economical fluids; although, in Ohio (Berea and Clinton formations), West Virginia (Big Injun formation) and Pennsylvania (Bradford series) many well owners still prefer this fluid. Where used, there is evidence that less sand returns to the well bore and better potentials are obtained. This may be attributed in part to ease in recovering the fluid from these low-pressure formations since the fluid possesses excellent viscosity-reduction characteristics.

The Bradford is one of the four principal shallow gas-producing zones in Pennsylvania. It ranges in thickness from 5 ft. at Bradford to a maximum of 40 ft. in Armstrong County then decreases to 25 ft. towards the south. Permeability varies from 0.3 to 3.0 md., porosity from 10 to 20%, and bottom-hole pressures average 950 psi. Primarily a solid body of sand, it contains a small amount of calcium carbonate, some illite and kaolinite clay materials, and a few shale lenses. Natural production ranges from 700 to 35,000 cu. ft. with an average of about 15,000 cu. ft.

Currently, a typical treatment consists of 4,000 gal. gelled kerosine carrying 6,000 lb. of 20-40 sand injected at 7 to 13 bbl. per minute. Production following is from 80 to 2,500 M.c.f. with average being 600 M.c.f. The decline rate is approximately 50% the first year, with second year's production rate being about 13% of the first month, and after 5 years this is down to 6 to 7%.[8]

Use of additives . . . Another more economical and versatile gelled hydrocarbon can be prepared by the addition of proper chemicals to crude oil, kerosine, or distillate. Among its advantages are low friction loss, low fluid loss, good sand-carrying ability, economy, and continuous preparation. Although it dilutes readily, an internal breaker may be added to expedite its reversion to a low viscosity which is particularly desirable in gas wells. Depending on well depth, reported injection pressures are as much as 1,000 psi. below refined oils and 4,000 psi. below that of emulsions with a resultant higher injection rate using the same applied horsepower. Addition of chemicals, gellation, and sand proportioning all can be accomplished simultaneously and continuously at rates up to 70 bbl. per minute.[9]

Field results . . . Gas-producing zones in many areas are being subjected to treatments employing this fluid with the Clinton formation in Ohio, the characteristics of which are discussed elsewhere, being one good example. Initially, typical treatments consisted of 800 gal. carrying 1 lb. of sand per gallon at injection rates of 2 to 3 bbl. per minute. The trend now is toward larger volumes using as much as 10,000 gal. carrying up to 2 lb. of sand per gallon at injection rates as great as 45 bbl. per minute. Small volumes give good results but wells treated with the larger volumes and higher rates have better initial production and decline curves, an average increase being about sixfold. See Fig. 1 and Table 1.

Treatments of the Tonkawa formation in the Texas Panhandle with this gel yield very good results. This is primarily a sand formation of Pennsylvanian age containing small amounts of acid-soluble materials. It lies 6,000 to 6,200 ft. below the surface and varies from 10 to 50 ft. in thickness with an average permeability of 123 md. and porosity of 17%. Bottom-hole pressure is about 1,500 psi. Natural production from this water-drive reservoir is 5,000 to 10,000 M.c.f. with some condensate. Fracturing treatments, preceded by 500 to 1,000 gal. of mud-cleanout agent, consist of 20,000 to 30,000 gal. of gelled kerosine carrying 1 lb. of 20-40 sand per gallon at injection rates of 30 to 40 bbl. per minute. Initially, production is increased approximately 10 times.

Gelled water . . . To fill a need for a fracturing fluid to be used in water wells (disposal, injection, or producing), a process for gelling water was developed. Gellation could be readily accomplished in fresh, salt, or oilfield-brine waters. Being economical, it was soon used in gas wells which produced from formations insensitive to water. Although the gel has low fluid loss and carries sand well, it offers moderately low resistance to pumping and readily reverts to a low viscosity. Special additives may be incorporated in the gel to make it more adaptable for fracturing some formations normally adversely affected by water. Representative cores may be tested in a laboratory to determine the most applicable materials.

The Atoka, a Pennsylvanian sand, is one of the principal gas-producing formations in northwestern Arkansas. Laboratory analysis, including X-ray diffraction, shows that the cores contain some salt and low-swelling varieties of clay. While cuttings will disintegrate in hydrochloric acid, they

are unaffected by water. A typical treatment there consists of 10,000 gal. of gelled water with as much as 25,000 lb. of sand injected at 7 to 12 bbl. per minute. Average production after treatment is reported to be approximately four times initial flow.

When treating some formations such as limestones and dolomites, varying amounts of acid added to the gelled water may be beneficial. Acid minimizes the undesirable effect on swelling-type clays during or after creation of a fracture. This modification and others are used in western Kansas, Texas-Oklahoma Panhandle, and Michigan.

Emulsions

Emulsions of controlled composition were introduced as fracturing fluids because of their high viscosity and excellent sand-carrying ability. Although not too stable to agitation and offering high friction loss, they were used quite extensively at low injection rates. Friction loss could be reduced in some cases by varying the formulation.

Emulsified acid offers a twofold action (chemical reaction and fracturing) on formations that are acid-soluble. Since acid is the internal phase of the emulsion, there is a retarded reaction rate which allows further travel from the well bore before the acid is spent. At the same time, high concentrations of sand can be carried into the fracture to effectively maintain it and the emulsion will break with time, temperature, and/or acid reaction.[10]

Used in several areas . . . One of the first uses was in Hugoton gas field of Kansas. However, there were indications that the acid was releasing material which plugged the propping agent with a resulting reduction in the flow capacity of the system; therefore, it was replaced here with oil and water-base fracturing fluids. Some application has been made on the relatively deep high-pressure gas-distillate wells in the Rio Grande Valley with varying degrees of success. These formations have a very low percentage of acid-soluble materials. Emulsified acid has been used successfully also in the Travis Peak and Cotton Valley formations of North Louisiana as well as some Pennsylvania formations in the Warrior basin of Northeast Mississippi.

In Ansley field (Mississippi) gas is produced from the Cuevas sand, a member of the Washita Fredericksburg formation of Lower Cretaceous age. Permeabilities average 50 to 60 md. per foot, porosity from 16 to 17%, and solubility from 8 to 15%. Although considered a dry hole, the first well fractured in this field (1956) currently produces 850 to 1,000 M.c.f. with 35 to 42 bbl. of distillate. Normal treatments employ 10,000 gal. emulsified acid carrying ¾ to 1 lb. of sand with injection rates of 2 to 5 bbl. per minute at pressures up to 10,000 psi. Usually only one 10 to 20-ft. interval is treated but sometime two are fractured. Average open-flow production before stimulation is 1,700 M.c.f., increasing to approximately 5,000 M.c.f. afterwards.

Emulsified crude was developed to carry large concentration of sand at relatively low injection rate. This prepared emulsion breaks after placement allowing rapid return of the fluid following treatment. Due to high friction loss its use is generally limited to relatively shallow depths. The trend toward large volumes and high injection rates has resulted in emulsified crude being replaced in most cases with more adaptable fracturing fluids.

True Fluids

Economy played a large part in the initiation of true fluids (refined and crude oils, water, and acid) as fracturing media. First of these were very viscous refined or crude oils; however, they did not return readily to the well bore, especially in dry-gas wells. Sometimes, those wells producing some water yielded emulsions following a treatment and when the fracturing oil was not compatible with produced condensate and gas, precipitates were formed which blocked the formation.

Low volume treatments . . . Initially, small volumes (5,000 gal. oil and 7,500 lb. sand) were injected at 5 to 10 bbl. per minute. These treatments with viscous oil were employed with varying degrees of success in the Texas-Oklahoma Panhandle, Four Corners, Michigan, North Louisiana, and Mississippi areas. Generally, they have been replaced with either less-viscous oils, water, or acid because the lower-viscosity fluids usually returned more easily following the treatment and had less friction loss. All these factors are adaptable to the large-volume, high-injection-rate jobs currently being used in so many areas.

Although larger fracturing treatments are being employed in several places, some formations respond equally to smaller volumes of lower-viscosity fluids. An example is the Wolfcamp formation in the Texas Panhandle where a medium-viscosity refined oil appears to be one of the best fracturing fluids. The Wolfcamp is a fractured dolomite of Permian period found at a depth of 2,200 to 3,300 ft. and varies in thickness from 100 to 250 ft. Average characteristics are 36 md. permeability, 14% porosity, 7% oil saturation, 49% water saturation, and 160 psi. bottom-hole pressure. Natural production is 10 to 750 M.c.f. When this formation is treated with 4,000 gal. of the special refined oil carrying 8,000 lb. 20-40 sand at 7 to 8 bbl. per minute, the average production increase is 13 times.

The use of nonthickened water as a fracturing fluid for gas wells originated in the San Juan basin of New Mexico in August 1955. Fresh and salt water in addition to oil-field brines have been used. The advantages of this fluid, which accounted for its spread to other areas, are economy and safety. Because of its economy, volumes continually increased, reaching as high as 350,000 gal., but generally these treatments did not show commensurate production gains. Average treatments now vary from 15,000 to 60,000 gal. per zone injected at rates up to 100 bbl. per minute depending on the area. Sand concentrations usually range from ½ to 1½ lb. per gallon.

Special chemicals are incorporated in some cases to make the water more compatible with the formation being treated, especially if it contains clays of specific types. Included in these chemicals are weak acid, calcium chloride and low-fluid-loss additives. Laboratory study of cores and proper use of these chemicals have made it possible to use water in many formations where it was previously deemed inadvisable.

Successful in San Juan basin . . . In the San Juan basin, the principal gas-producing formations are Pictured Cliff and Mesaverde. Average properties of the Pictured Cliff are permeability 5.5 to 8.1 md., porosity 17 to 21%, and thickness of 30 to 40 ft. Usual treatments are about 60,000 gal. fresh water carrying approximately ¾ lb. of sand per gallon injected at 55 bbl. per minute. Average deliverability at pipeline pressure is reported to be 15.5% over initial open flow potential.

The Mesaverde formation is composed of three members: Cliff House, Menefee, and Point Lookout. Average figures for the entire Mesaverde are 1.5 md. permeability, 9.5% porosity, and 120 ft. of productive formation. Normally each member is fractured individually with 30,000 to 60,000 gal. of water carrying 1 lb. of sand per gallon at an injection rate of 30 to 100 bbl. per minute. Each zone is isolated by bridging plugs, perforation ball sealers, or a combination of

these. Generally, deliverability at pipeline pressure is stated to be 24% over the initial open-flow potential.[11]

Although the use of unthickened acid as a fracturing fluid is relatively new, some outstanding results are being obtained when applied to gas-producing formations. As with water or any other low-viscosity fluid, high injection rates are required. Fracturing efficiency can be improved by the addition of a fluid-loss-control additive especially designed for acid. Not only can any strength acid be used but proper nonemulsifiers and other additives may be incorporated as needed.

Additives and Variations

More gas flow and better declines have been obtained by the introduction of numerous additives and technique variations for increasing fracturing efficiency. Small amounts of special fluid-loss-control agents may be combined with most fracturing fluids to increase their fracture extension efficiency. They operate on the theory that during the creation of a fracture, an ever-increasing amount of surface area is exposed. Fluid lost to this surface has no part in extending the fracture; therefore, fluid loss has a great influence on radius of fracture. Several of these additives have been developed for oil with some being completely oil soluble, others only dispersible. Specific ones also have been designed for use in water and another for acid.

Multiple fractures . . . The possibility exists that more than one fracture may be initiated during conventional fracturing treatments; however, procedures have been developed to assist in the intentional creation of multiple fractures. Formations with laminated shale sections or wide variations in permeability are usually good subjects for these treatments. After a fracture is produced, it is temporarily sealed or bridged by one of these techniques with additional fluid being diverted to another portion of the zone.

Granular-type materials having specified properties have shown to be most effective for quickly sealing and bridging fractures. These should be slowly soluble in either the produced or fracturing fluid so they may be removed following treatment. Wells in the eastern area of the United States and in the Texas Panhandle have benefited considerably from their use.

Tough viscous gels will seal sufficiently in some formations. In gas wells it is highly desirable to use gels that revert to a low viscosity after a short period of time, to help prevent plugging effects. Occasionally, a combination of granular and gel materials is needed to adequately divert the fluid. The Texas-Oklahoma Panhandle has found this method to be especially successful.

Perforation ball sealers are another multiple-fracturing aid applicable to wells producing through perforated casing. Specially constructed rubber or plastic balls larger in diameter than the perforations are injected at selected intervals during a fracturing treatment. These balls seal the holes taking fluid, thus diverting flow and pressure to other perforations. They are removed when pressure is released or when reverse flow is obtained after treatment. A good bond between casing, cement, and formation wall is important for best results. This multiple-fracturing technique is being used extensively in the San Juan basin of New Mexico and in the Texas - Oklahoma Panhandle.

Special Chemicals

When considering means for production stimulation, explosives, acidizing, and hydraulic fracturing are usually thought of first. It is quite common to overlook the fact that special chemical treatments alone are credited with a large number of production increases. These materials which consist of surfactants, mud-removal agents, sequestering chemicals, and others are frequently used ahead of or in conjunction with fracturing or acid treatments as well as by themselves.

Increasing production . . . Often, during the process of drilling and completing a well or during its producing life, emulsions, water blocks, or other impediments to flow will be formed proximate to the well bore. These conditions may severely restrict the production of gas even from a well with good bottom-hole pressure. Use of a special chemical will frequently correct the condition at relatively low cost to the well owner.

Surfactants are available for use in either oil or water-base fluids and serve as an aid in the removal of water or emulsion blocks. By reducing surface and interfacial tensions between the hydrocarbon and water, they break emulsions and permit easier migration of these fluids to the well bore.

When drilling muds or formation fines are forced into the formation permeability and resist removal by reverse flow, acid-base cleanout agents serve to remove these and many other production blocks. Acid cleanout agents are available in two basic types. One acts to shrink swelling-type clay particles and to dissolve calcareous materials. At the same time, an incorporated surfactant acts to keep the particles in suspension and to break emulsions. Normally, this fluid is forced into the formation and permitted to react before removal. Treating the Sparta series near Opelousas, La., with this agent frequently increases the gas flow up to tenfold with a substantial amount of distillate produced.

Action of the other type mud-removal agent depends more on the dissolving of, or reaction with, the plugging material. Often it is recommended that this agent not be injected into the formation but be used only as a wash.

Gas Storage

Although all of these stimulation techniques normally are only considered for producing wells, they are being used in some areas to increase the efficiency of gas-storage wells. Several gas-producing formations are being used as storage reservoirs. In the Appalachians, wells that have been completed in the Clinton and Medina sands, as well as several shallow zones, are serving this purpose. Fracturing has not only increased the input rate of these wells but withdrawal rates are reported to be higher than before treating.

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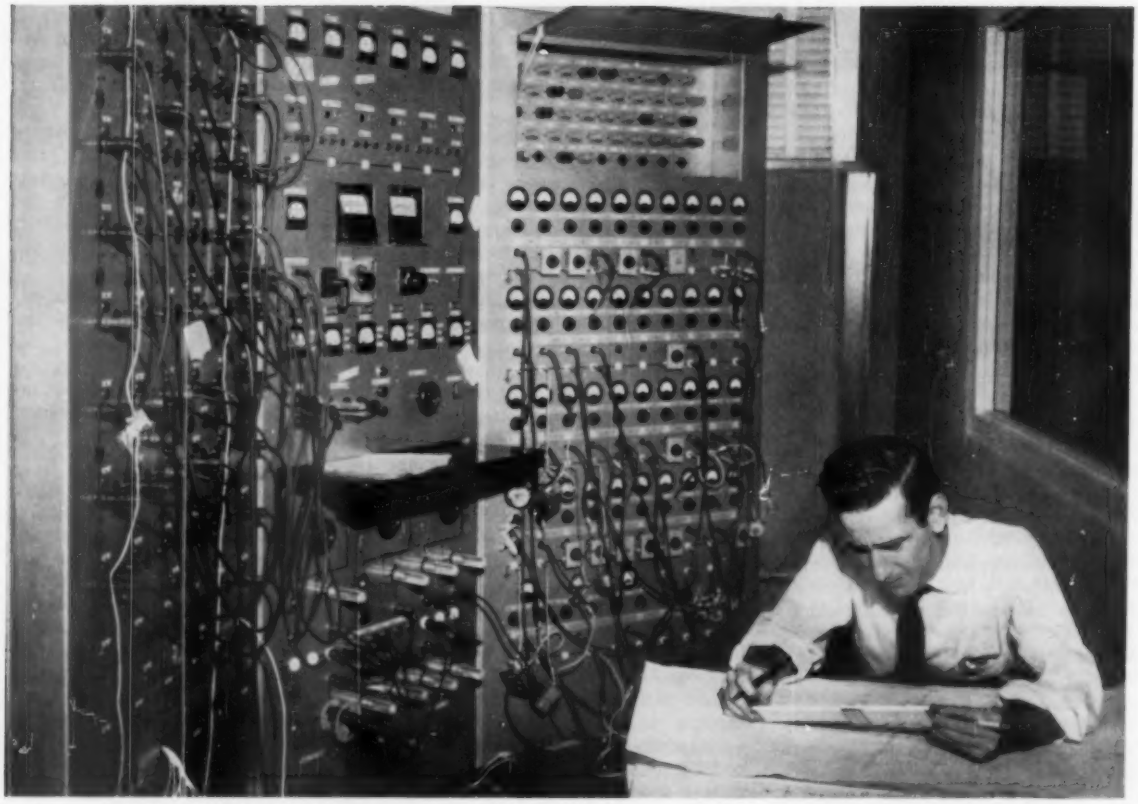


SPECIAL ANALOG COMPUTER solves a variety of problems at Midwest Research Institute. Fig. 1.

Pipeline analyzer speeds flow computations; shows promise of becoming an efficient "traffic cop"

BY PAUL C. CONSTANT, JR.
Midwest Research Institute

THE McILROY pipeline analyzer was conceived by Prof. Malcolm S. McIlroy to eliminate the tedious Hardy-Cross computations required in studies of flow and pressure distributions in complete pipeline networks. Today the analyzer is being used for numerous studies for both constant and variable-density fluid-flow piping systems.

It is conceivable that in the immediate future, wider applications for this computer will be available. The field is certainly open for the person with imagination. One further use of the analyzer that is being considered at Midwest Research Institute is that of certain phases of the traffic problem.

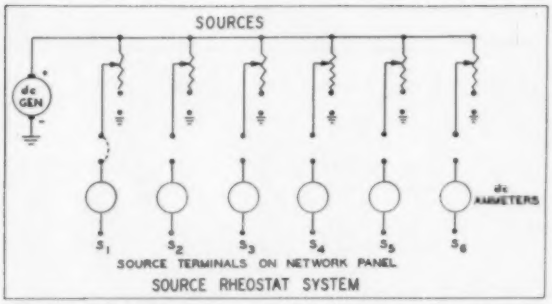
This special-purpose analog method is based on an electrical simulation of actual pipelines. It provides an easy, rapid, and flexible method of evaluating flow and pressure drops across individual lines, and total pressure drops across all or any part of the network.

It readily permits easy comparisons of performance when alternate plans are proposed for additions to or improvements in, the pipeline network and its sources of supply.

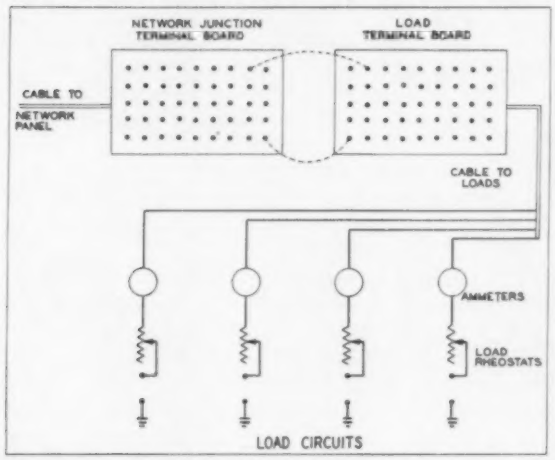
How the computer works . . . Since several papers[1 2 3 4] have discussed the mathematical analogies of the analyzer, only a discussion of the components of the computer and how they are used will be given here.

Basically, the McIlroy analyzer is a special-purpose analog computer used for solving instantaneously a system of simultaneous equations. It is a passive system using nonlinear resistive elements, fluistors, to represent pipelines, and linear resistors (rheostats) to represent loads (consumption points). A d.c. generator furnishes voltage and current which are analogous to pressure and flow respectively. Precision voltmeters and ammeters are used to read the pressure drops and flows.

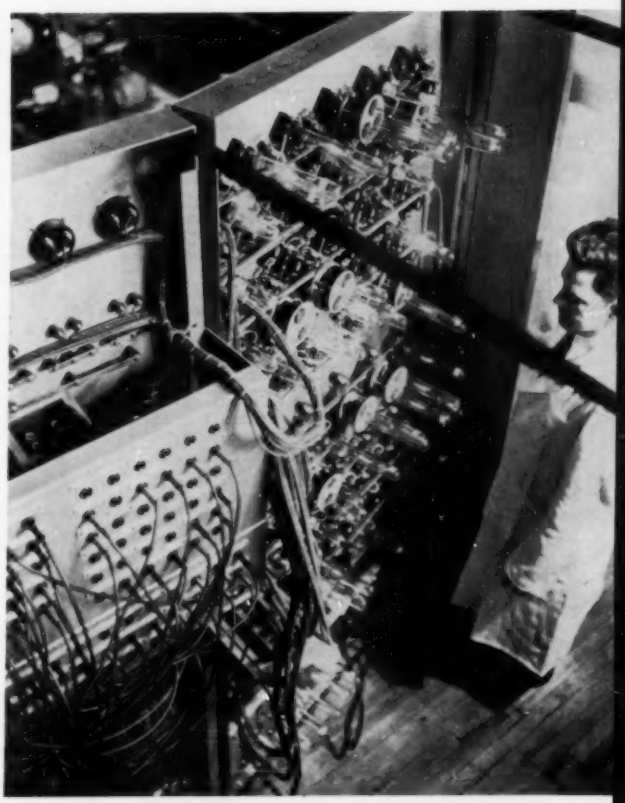
The analyzer at MRI, Fig. 1, has a network capacity of 126 lines fed by six isolated sources serving 47 individual loads. The network occupies two left panels, and the loads are housed on the panel to the right. The center section (below shelf) has six individual source points, connected as shown in Fig. 2a. The upper half of the center panel contains all the necessary meters for making the required pressure and flow measurements in the network. The individual



CENTER SECTION has six individual source points. Fig. 2a.



INDIVIDUAL LOADS have ammeters permanently connected in their circuits. Fig. 2b.



FLUISTOR NETWORK and patch panels are shown in rear view. Fig. 3.

loads (right panel) have ammeters permanently connected in their circuits, (see Fig. 2b).

These loads may be connected to the approximate places in the network by making use of the terminal boards as shown in the same figure. These patch panels are situated on the back side of the center panel of the analyzer. The fluistors, elements which correspond to lines in the physical system, are put in their proper network positions on the reverse side of the left panels (see Fig. 3). The receptacles on the network panels as shown in Fig. 1 are available jacks for inserting ammeter and voltmeter plugs for obtaining the pressure drops across various points in the system and measuring flows from sources of individual lines.

Setting up a problem . . . Actual setting up of a problem on the analyzer requires completion of a certain amount of preliminary work, obtaining sufficient data to permit electrical simulation of the system. The minimum data needed include:

1. A schematic diagram of the pipeline network showing the operating conditions known, or assumed to exist, at all sources and loads.

2. Friction coefficients for each pipeline.

3. Units employed (m.g.d., g.p.m., c.f.p.m., and other units).

4. Assurance that the network operates in the turbulent-flow region (Reynolds Number greater than 2,400), flow essentially steady, and no appreciable thermal gradient.

With the above information, and after selecting the three conversion factors B, G and O^5 that will suitably fit the problem to the analyzer, two work sheets are usually made up for convenience of wiring and setting the system on the computer. These work sheets are shown in Figs. 4 and 5.

Fig. 4 is a work sheet for the loads and sources to be used in the analysis. The first column is self-explanatory. The second column is used to designate the junction points on the computer board (Fig. 5) where the loads are actually placed. Columns four and five are to represent the actual consumption at these load points. A similar representation for sources is made in the small table at the bottom of the figure.

Fig. 5 represents the extent of the computer network. Here, the system to be studied is drawn. Each circle represents an available pipeline. The fluistor coefficient which represents the pipelines of the system are put in their appropriate circles, and the necessary jumpers are drawn in so as to correctly tie the system together. The smaller circles noted by S_1, S_2, . . ., S_6, represent the available sources.

When these two forms have been filled out and properly represent the problem, the computer is then wired and set according to this information on the two work sheets. After a check has been made of the problem set up on the computer, the power is turned on. A field rheostat (main control) is then varied to bring the sources to their proper values and the loads are adjusted. Then with the system in the proper operating conditions, the necessary studies are started.

Investigations . . . The most common problem faced by the users of the analyzer at MRI has been that their water or gas system was becoming heavily loaded, and that some form of expansion or reinforcement was needed. Usually the study consisted of determining the most economical means of reinforcing the present sys- At the same time, desirable modifications of the present system which

McIlroy Analog Computer - Load Circuits

Sponsor _____ B = 0.01 volts/ 2

Analysis of _____ G = 0.02 amps/ ~~ltrgh~~

No. _____ Date _____

LOAD NO.	NETWORK TERMINAL	FLOW IN	AMPERES	NOTES	
L-1	11	2.3	.043		SAFE CURRENT 0.5 AMP.
L-2	16	3.5	.066		
L-3	4A	4.2	.084		
L-4	53	8.3	.166		
L-5	1A	8.9	.178		
L-6	35	10.6	.212		
L-7	17	12.2	.244		
L-8	12	17.6	.352		
L-9	62	22.0	.440		
L-10	42	23.0	.460		
L-11					
L-12					
L-13	66	38.6	.772		SAFE CURRENT 1.0 AMP.
L-14	63	43.7	.874		
L-15	80	48.0	.960		
L-16	65	48.9	.978		
L-17	86	49.9	.998		
L-18					
L-19					
L-20					
L-21					SAFE CURRENT 0.5 AMP.
L-22					
L-23					
L-24					
L-25					
L-26					
L-27					
L-28					
L-29					
L-30					
L-31					
L-32					
L-33	64	52.5	1.046	Parallel	SAFE CURRENT 1.0 AMP.
L-34	64			these two	
L-35				loads	
L-36	82	57.3	1.146	Parallel	
L-37	82			these two	
L-38				loads	
L-39					
L-40					
L-41	32	64.4	1.29		2.0 AMP.
L-42	36	87	1.74		
L-43	52	199.3	3.99		4.4 AMP.
L-44					SAFE CURRENT 0.0 AMP.
L-45					
L-46					
L-47					
		802.0 TOTAL	16.04 TOTAL		

/ Parallel these /

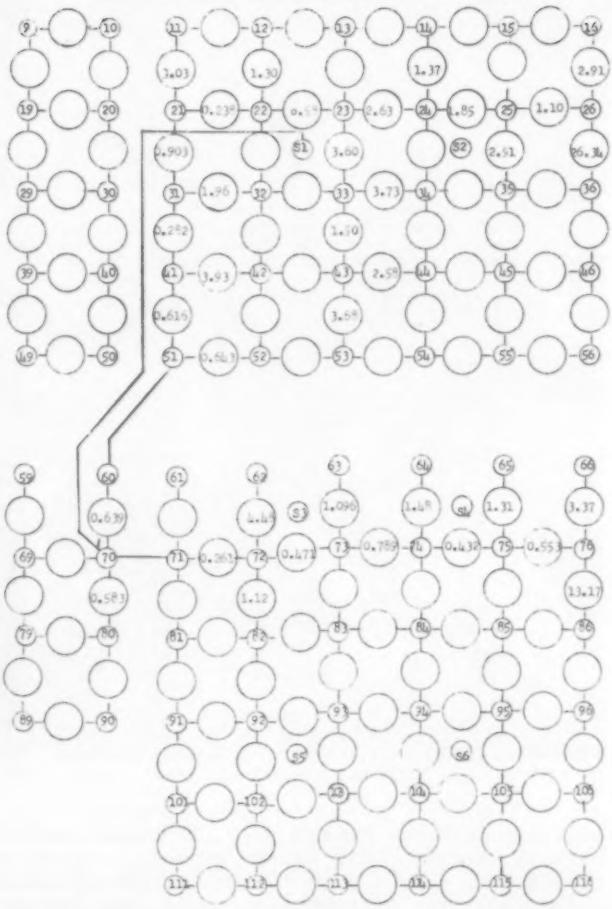
Source	S-1	S-2	S-3	S-4	S-5	S-6	TOTAL
Term	70	70					
Flow	802						
Amp.	16.04						

Operated by _____

LOADS AND SOURCES to be used in analysis and . . . Fig. 4.

McILROY ANALOG COMPUTER NETWORK LAYOUT

ANALYSIS OF _____ NO. _____



NETWORK LAYOUT worksheets aid in wiring and setting system on computor. Fig. 5.

would aid in further expansion were sought.

Each problem is different, but in most cases complete studies of the systems have been made, resulting in typical analyzer applications for water and gas-pipeline network problems. Some of these applications are:

1. Effects of choice of elevation of reservoirs or storage tanks.

2 Selection of the proper rating for pumps.

3. Selection of pipeline diameters for best combination of economy and performance.

4. Determination of the best location for pipelines.

5. Locating the source of operating difficulties or bottlenecks in existing networks.

6. Comparing alternate arrangements of systems planned for construction.

7. Evaluation of pressure variations.

8. Checking the operation of transmitting systems.

9. Optimizing a system so as to minimize the number of sources required.

If one studies the nine applications listed above, it becomes apparent that they are not all necessarily independent. As an example, in optimizing a system, the size of the pipeline may determine the number of sources that are required. Hence, it may be that by merely replacing a section of 8-in.-diameter pipe with 14-in.-diameter pipe, a source will be rendered superfluous.

The approach to a problem will depend, to some extent, on whether the system under study is: (1) an existing one, (2) a proposed extension or addition, or (3) an entirely new system. In addition, such factors as available funds, accuracy of projected estimates for future growth and consumption needs, and accuracy of input data may need to be considered.

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2. McIlroy, M. S., "Direct Reading Electric Analyzer for Pipeline Networks," Jour. AWWA, 42, No. 4, p. 347 April 1950.

3. McIlroy, M. S., "Water-Distribution Systems Studied by a Complete Electrical Analogy," Jour. NEWWA, Vol. LXV, No. 4, pp. 299-318.

4. McIlroy, M. S., "Gas Pipe Networks Analyzed by Direct-Reading Electric Analogue Computer," AGA, April 1952.

5. See Appendix, Part 2, to be published in The Oil and Gas Journal, April 14, 1958.

This is the first part of a two-part article. Part 2 will appear in an early issue.

MODERATOR

J. D. Walk
American Oil Co.
El Dorado, Ark.

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OPERATORS' PANEL

John F. Anderson
Cooperative Refinery Association
Coffeyville, Kans.

Bruce Jones
La Gloria Oil & Gas Co.
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T. J. Byrne
American Oil Co.
El Dorado

J. M. Killen
Standard Oil Co. (Ohio)
Cleveland

J. E. Eppard
D-X Sunray Oil Co.
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Ralph L. Reynolds
Lion Oil Co.
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Des Plaines, Ill.

Richard R. Haig
Esso Research & Engineering Co.
Elizabeth, N. J.

Donald E. Womeldorph
Houdry Process Corp.
Philadelphia

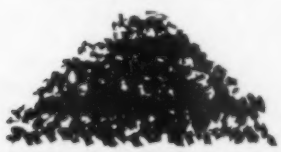
B. F. Hartman
Socony Mobil Oil Co.
New York City

Listen in as these men—experts in their field—give off-the-cuff suggestions in a WPRA panel discussion about such refinery topics as cat cracking, cat reforming, alkylation, and others. Their answers can help provide

Part 1 of Four Parts

Useful tips on refining problems

CATALYST SINTERING



CATALYST SINTERING: What is the cause of catalyst sintering and the effect of cat-cracker operations and product distribution? What is sintering?

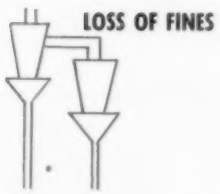
ANDERSON: First of all, we might start in with "What is sintering?" We normally take the approach in fluid units that catalysts are in small ball form, and have a great deal of surface area, possibly containing many small holes. In the sintering process, we feel that this large surface area more or less becomes fused and presents one solid surface, such as a grain of sand compared to a sponge.

As to the cause of sintering, most of it occurs in the regenerator where you can run into excessive temperatures, probably in the order of 1,200° F. or over. This comes either through localized hot spots in your regenerator or afterburning or anything that will give you high temperatures in your generator.

The effect on the operation: First of all, we feel that it lowers the activity of the catalyst a great deal and if you have serious sintering you more or less revert to a low-pressure thermal-cracking operation rather than a catalytic-cracking operation. You probably have to go to higher temperatures and higher levels in your reactor, and you will produce more dry gases and also get a decrease in octane number on gasoline.

HARTMAN: Speaking of moving-bed cat crackers—of course, heat is primarily the cause of sintering in that particular type of operation. Maximum temperatures of 1,400° are generally adhered to in operation of kiln. As a result of poor distribution of oil on the catalyst, it is not unusual to have some very hot spots in the kiln. In so far as its effect upon yields, I think the comments that have already been made on fluid operations are very similar to what would be expected in a moving-bed type of unit. Certainly the catalyst is less regenerable when subjected to heat damage.

*At present associated with Texaco Development Co., New York City.



LOSS OF FINES: What and how much is the effect of the loss of the 0-40-micron-size particles on: (1) activity, (2) fluidity, (3) product distribution, and (4) regeneration?

REYNOLDS: Well, I would like to open by saying that loss of the 0-40 micron certainly has a bad effect on all these: activity, fluidity, product distribution and regeneration. Even a small reduction certainly affects your fluidity. The case I speak of in particular is a large loss of 0-40 micron in the range of a loss from 13% down to around 7 to 9%.

In a case like this the fluidity is abruptly effected and circulation extremely hard to maintain under those conditions. As a result it becomes necessary to try to increase the 0-40 micron component and, of course, the easiest way to do that while you're operating is to add fresh catalyst which is high in those components. This in turn affects the activity and you find in trying to offset poor fluidity you get into an activity problem on a high side as a rule, but it varies badly as you try to add 0-40 micron sizes to an existing system. So your activity is up and down and very hard to predict in these cases.

The product distribution in such cases varies with the activity variation and in general results in a decrease in dry gas and coke. In losing 0-40 microns from 13% down to 7% or relatively half of your 0-40, you come upon regeneration problems.

In general, it requires approximately 5% more air to burn your coke and your coke level tends to ride at a higher level than ordinarily. The main effect is on the fluidity and even a small change in the 0-40-micron range effect fluidity so that it becomes a controlling factor and all these other problems result from trying to control the fluidity in order to maintain an operation.

ANDERSON: We had quite an experience along this line in one of our fluid units. We found that these 0-40 micron particle sizes had an activity of 55 to 60 UOP. You don't want to get below 6% and preferably up around the 10% mark. A good catalyst should also contain 12 to 15% of 40 to 50 micron material. It has a tremendous effect on the fluidity in a unit. Of course, if you have poor fluidity, everything else goes to pot in a fluid unit. We were able to increase activity on one unit from 16 to 40 UOP by making changes that resulted in holding more 0-40-micron catalyst. So, you can see that it has quite an effect.

HAIG: Do you add catalyst batchwise, or do you add it continuously? Perhaps a lot of the surges of activity might come from adding your fresh catalyst all at once.

REYNOLDS: Most of it was added batchwise, but an attempt was made to add continuously with better success than when it was added batchwise.

HAIG: If added continuously over the entire operating day, you will avoid a lot of these surges of activity which in turn give you the problems of high carbon on catalyst and perhaps afterburning.

REYNOLDS: We have had mechanical problems in trying to add catalyst continuously in a small enough amount to keep the activity from running away with us.

WALK: Do you care to give him the details of your continuous catalyst-addition system?

HAIG: We add continuously through a dilute-phase air line. The catalyst flows through a sight glass before being picked up by the air.

REYNOLDS: If you could get continuous addition instead of batchwise, it would help, but, as I said, we find it hard to do.

EPPARD: We had this trouble recently on our FCCU at Duncan and we feel that we know how much fines we need to keep in our unit to maintain good fluidization. I agree with the rest of the members that the main trouble when you lose fines is due to loss in fluidization, and the other troubles stem from poor fluidization. We split the floor in our plenum chamber and started losing fines. The first change we noticed was that our catalyst losses started going up and increased each month. Before our trouble started, we had 35% below-50 micron and before we shut the unit down the minus-50-micron fraction was approximately 8%.

Our regenerator operates with a low linear velocity—1.5 ft. per second—and poor fluidization gives us some rather unique operations. We would burn the catalyst white in our regenerator and then within 15 minutes we would be in high carbon—over 1% coke on the regenerated catalyst. By the time we would get out of the high-carbon stage we would lose circulation again. We fought the operation for a long time and the only way we could really make the unit behave was to add a large slug (30 tons) of new catalyst. Whenever we would add large quantities of new catalyst and get some fines in the unit, it would run all right until the fines were lost.

We found that as long as we keep above 25% below-50 microns, we should get good fluidization. There were indications that we were getting very poor fluidization in our reactors because our coke yields were high, and the hydrogen of $C_1 + C_2$ ratio in our tail gas was (over one at one time), in the neighborhood of 0.8 where normally we operate with 0.4 ratio. Our tail gas would have 40 to 45% hydrogen in it. The only cure for our trouble was to shut down and fix our cyclone so that we could retain the fines.

McMAHAN: We have knowledge of a unit that operated—granted, with circulation difficulties, but with satisfactory product distribution and with satisfactory regeneration — when the catalyst contained nothing smaller than 60 microns.

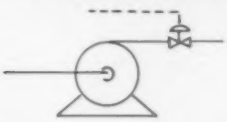
COMMENT: I note that most of the panel members have commented on adjustment of particle-size distribution through addition of catalyst. I know that some units have either attrition devices or allutriation and I wonder what recent experience has been on adjustment of your catalyst inventory through those methods?

COMMENT: After we shut our unit down, fixed our cyclones, and came back on, we started up with 50% new catalyst in the unit and then we had an allutriator that we put in service. We ran it for about 6 weeks and got rid of most of the heavy ends we had collected in the unit. Then we saw our fines coming up and our plus 80 was going down, so we shut our allutriator down. We completely readjusted our size by both the allutriator and the addition of catalyst. We did not try using any attritors to grind up the catalyst, where we were having the trouble, the reason we didn't have was because our cat losses had topped 1 lb. per barrel and were going on up. Finally, we hit 1½ lb. per barrel and when we ground it up, we just couldn't keep it in the unit.

HAIG: I wonder if I could add an-

other comment, slightly unrelated. I was thinking of our fluid coking units where we circulate much coarser particles. Of course, there we don't have a problem with activity of product distribution with the inert solid, but, at a much larger particle-size level we do find a very definite effect on regeneration. It's more up in the range of two or three hundred microns being the break point, rather than at 40 microns. There, all the surface area is on the outside of the particles and once they get too coarse they just don't consume all the air going through and we run into afterburning. At the same time, we run into fluidity problems. This is a little bit off the subject, but, I just wanted to say that these large particles can be circulated.

COMBUSTION AIR CONTROL



COMBUSTION AIR CONTROL: Does anyone automatically control FCC combustion air? If so, how?

EPPARD: When we were having this trouble with our fluidization problems, we installed a temperature control to automatically control the air to the regenerator. It worked very well and we have continued to use it with very good success. It makes all the trim adjustments on our air and the operators still manually make the major adjustments. Our control is based on the principle that we operate with continuous afterburning, that is, controlled afterburning.

The way you can put out afterburning is cut air and starve out the afterburning. If you want a unit to go into afterburning you just increase the air. We thought at first that we would need a differential temperature controller to hold a set differential between the regenerator bed and the cyclone outlet, but we found after we put the air-control system into operation that an ordinary temperature control on our cyclone outlet would make the trim changes necessary on our regeneration air.

We operate with a regenerator bed of 1,150° to 1,175° and set the outlet of our cyclones at 1,190° to 1,200° F. We end up with about 0.3-0.4% oxygen in our flue gas and a CO_2-to-CO ratio of approximately 1.0. We operate with a small amount of afterburning. Above the bed and as coke make increases, it consumes the excess air and puts out the afterburning which causes the outlet temperature of the cyclones to decrease and the controller then opens and puts more air into the regenerator.

As the coke yield decreases, you have more excess air and the afterburning starts increasing which caused the temperature on the outlet of the cyclones to go up and the controller cuts back the air, and puts out the excess afterburning. On our unit, we're using about 40 M.c.f. per minute of air and we control about 5% of the total—using an 8-in. butterfly valve with about 3 or 4 lb. pressure drop. This method was not original with D-X Sunray but was first used by Frontier in Cheyenne, Wyo.

JONES: I don't think that I could contribute much more, since we're not presently automatically controlling the combustion air to our unit, but, we're revamping our unit to do it in a manner much similar to that described by Jack Eppard.

REYNOLDS: Well, since there is some question just exactly what this question meant here, we thought we might describe a control that is not dependent on a variable in the regenerator or the O_2, or some other variable, just a method of control in the flow. In our case, we have a pressure controller that operates the governor to the turbine drive and varies its speed with the pressure. In the discharge line there is a butterfly valve that is operated by a flow controller. This butterfly valve takes a pressure drop in the order of 6 to 7 lb. Then the flow rate is varied by the operator to meet the air requirements of the coke laydown situation.

BYRNE: Well, it seems to us that most any method of control in combustion air is somewhat of a luxury because it wastes cat-cracking capacity. We operate on the basis of using all of our combustion air and making enough coke to use it up. We do, however, control the speed of the turbine drive on the blower for our air to keep us near maximum air at all times, but, of course, not close enough to risk kicking the machine off.

WALK: It looks like there are two schools of thought—one is to burn all you can, all the time, and the other is to burn a little less than that and do it real neatly. Are there any comments on this subject?

PARK: (Pure Oil Co.) I'll admit that was our question. We have been exploring this possibility of controlling combustion air automatically, and one of the things that we did was to install a temperature - differential recorder in preparation for installing a combustion air controller from the temperature-differential recorder. We took that temperature difference, as Jack Eppard stated, from the regenerator bed to the cyclones and we were amazed at the variation.

We had thought that from the original recorder which simply recorded the two temperatures, that there would be a nice even fluctuation depending on some slight variation on the feed stocks or something of that effect, now, instead we got anywhere from a 15° to 20° or maybe 25° variation that was almost constant, wihin half a minute or so.

So, we decided that the only thing that we could go to, if straight temperature itself could not control—and we weren't sure it could at the time, until I heard what Jack has had to say here—was to put several thermocouples in the regenerator bed because evidently the cyclone temperature remains fairly constant. But, due to the eddy currents and so on in the regenerator bed, evidently that temperature doesn't remain so constant. Jack Eppard, I wonder if you fellows had explored that possibility of putting more thermocouples in the regnerator bed.

EPPARD: Yes, we looked at the various temperatures we have recorded on our regenerator and could not quite see how the control would work. However, it had a sound theoretical basis and had been used so we installed the controller. The controller may hold the same setting for 8 to 10 hours at a time. Then there will be some change (small) in the unit, such as our feed stock, and the controller will make the necessary adjustments. The controller is set very slow so that it does not make fast adjustments. George Adams might have some comments on that.

WALK: Well, may I ask just one more question before George speaks? What variations do you get in your cyclone temperatures with this type of control? Do you go up, say, as high as 1,250°, or anything like that?

EPPARD: Only during upsets will it get up to 1,250°. Normally, it holds the outlet of the cyclones within 10°. The generator bed itself may vary from 1,150° to 1,175° throughout a 24-hour day.

ADAMS: (D-X Sunray) I have several comments. The idea as far as I know, as Jack stated, was originated at the Frontier Refinery at Cheyenne. The

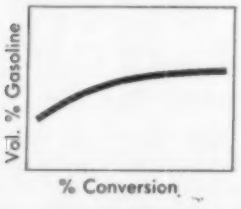
fellow responsible is their operating foreman, Hollis Spencer, so he ought to get a plug for it. The system of controlling on the flue-gas outlet temperature, instead of controlling by differential, actually seems to be more stable for regenerator operation.

Apparently, when you get a tendency toward burnoff in your bed, if you are controlling the flue-gas temperature itself, instead of the differential, it tends to discourage the burnoff by restricting the excess air somewhat. On the other hand, if you get a buildup of carbon and your regenerator bed temperature is sliding down, it tends to give it a little extra air by increasing the afterburning slightly and discourages the tendency toward the temperature slumping. So, I would actually prefer flue-gas temperature control to a differential.

Another thing, it's very economical with air because you regenerate with a very small amount of excess oxygen and if you're careful, you can use up almost all your air. I think it's more economical there than the system of trying to keep the afterburning extinguished and running, say, a per cent of excess air. Another advantage of the system is that if it is run properly it is almost impossible to get behind on burning and get a carbon buildup.

That is one easy trap to fall into when you have a hot regenerator and have to run with a small amount of excess air, and you try to keep the afterburning extinguished. It gets so that the operators in keeping the afterburning extinguished fall into the problem of building carbon on the catalyst and then get into the troubles that are encountered in getting the catalyst burnt clean.

OPTIMUM CONVERSION



OPTIMUM CONVERSION: What is the optimum conversion on FCU units — assuming excess thermal-cracking capacity? Describe methods for determining optimum?

BYRNE: It seems the problem of determining the optimum conversion for any cat-cracking unit is like the question, "What's the optimum shoe size?" —and it would depend on the size of the foot. We find that the optimum conversion for us is the most we can get. It is conceivable that you could exceed an optimum if your cat-cracking capacity was out of proportion to your crude running. But, in general, it's just a problem, possibly it is the type of problem that a computer could be used to advantage on.

Basically, you must set up several cases of higher and lower conversions, using your present operation as a base with its yield structures. You will then use either published correlations, or those which you have developed, to predict the changes in yields of gasoline, butanes, propanes, gases and gas oils, for the various changes on the cat-cracker conversions.

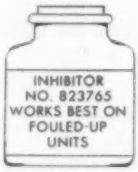
There are two bases on which you can change a conversion. One would be on the basis of constant coke burning rate. That's the basis we normally use since our coke burning is limiting. It may be necessary to adjust your feed rate or your recycle ratio. Then you would predict the yield structure for the incremental or decremental cycle oils in thermal cracking. You would extend the prices then for these various yields in each case, including the base operation.

These yields then would be plotted as total dollars per day realization versus your cat-cracker conversion. Then from your plot you could select your optimum as the maximum dollars per day realization. One thing you must be careful of is to consider your recovery factors in your vapor-recovery equipment so that the proper amount of butanes and propanes end up in fuel gases instead of in your alkylation or polymerization reactions.

HAIG: First of all, it has been our experience that the maximum conversion is not always the optimum. It depends a great deal on what the markets are—I think you'll admit that. I know that in a lot of our cases we are finding that diesel fuel or heating oil is just as valuable as, or more valuable, than gasoline. Obviously, there isn't much point in cracking that up just to get high conversion per se. As to how to determine the optimum, I'd rather put it so that we keep trying to get a closer approach to the optimum. I don't think we'll ever hit it. It's a pretty complex thing to hit. It used to be the case that we would start out with a feed stock and look at three conversion levels and each of those at three different temperature levels, and perhaps three different recycle rates and recycle boiling ranges. That got to be quite a laborious calculation, as anyone can see, and an obvious candidate for programing on a computer. That is how we try to approach the optimum nowadays. We have all our cracking correlations programed for computer use so that all that is needed is to put in feed stock characteristics. Plant recovery factors and product values can be included in the computer program. The optimum conversion is the one that gives the highest over-all product value.

WALK: I think it is obvious that the optimum is different with each refinery and probably is different for the same refinery depending on the season. Are there any other comments on this optimum conversion or does anyone have any other tricks on how to find it? I think it is something that we just strive for. I don't think any of us can say we ever had it.

INHIBITORS



INHIBITORS: What corrosion and/or fouling inhibitors have been used successfully on FCC gas-recovery systems and alkylation units?

REYNOLDS: We have had fairly extensive use of amine-base inhibitor, Nalco 161 type, in the FCC gas-recovery system. We have found that this particular compound is highly effective in reducing corrosion and fouling in gas-recovery systems, and in the FCC unit. A contributing factor to that, I think, is the presence of quite a bit of free water at various points. Where there is condensation of steam and free water to work with this Nalco 161 we find that our overhead condensers and accumulators, following the equipment on down through the debutanizers, receive a lot of benefit as far as moving the products of corrosion along, and that we have been able to withdraw them with water.

In the alkylation unit, we have had some experience with this particular compound too. It will certainly clean, or keep clean, the heat-exchange equipment. But, the lack of moisture there seems to raise some question—is this really necessary or is it as effective as something else might be? In an alkylation-isobutane circulating system, it will reduce drastically the amount of iron traveling around with your hydrocarbon, but beyond that we haven't been able to determine just how much corrosion protection we are getting.

JONES: We do not use any corrosion inhibitors in our cat-unit gas-recovery system. We simply wash main-fractionator vapors with water. On our alkylation unit, however, we have had extensive experience in this respect. I went into this matter in quite some detail last year in a similar question at this meeting. It may be of interest to briefly summarize those points again. We have sieve-deck-type trays in all of the fractionating columns at our sulfuric acid alkylation unit, and we had considerable difficulty during initial operations with plugging and fouling of these trays.

We finally decided to use MEA plus a filming amine (that is dispersible in water) not only to build up a protective film but with the MEA actually neutralize the SO_2 (which is evolved from the decomposition of the neutral esters that come through the caustic-water wash system).

We now, and in fact for about the last 18 months, have been adding this Petromeen-MEA combination (something like 5 to 10 p.p.m.) into the overhead of our deisobutanizer and rerun columns, simultaneously injecting it into the feed of each of these columns as well as the debutanizer column. We still have some fouling and corrosion, but we have reduced the iron content of the water very substantially, and also, have realized much longer onstream times.

ANDERSON: Our general experience is along the line of Ralph Reynolds. We presently add water just ahead of our low-pressure coolers. The water amounts to 10-12 g.p.m. with a small amount of inhibitor. We have tried several kinds of inhibitor: Nalco 161, Kontol, Polyrad, and a few others. We were able to substantially reduce the iron content of the water. By the way, this water goes on through and is withdrawn from our stripper-charge drum in the gas-con unit, and for a while we ran iron contents of up to 50 to 60 p.p.m.

Now we are down to a range of 5 to 8 p.p.m. It also stopped a condition that was very susceptible for hydrogen blistering in our stripper overhead system. At one time, we did have quite a few cyanides present there. Now all our water has a negative cyanide spot test which is a good indication that the condition for hydrogen blistering is gone.

GOLDSBY: In alkylation, the amount of fouling and corrosion, or the amount of trouble you have, will depend largely on the type or quality of your alkylation operation. If your operation is good, such as is being experienced in many of the new units, there won't be much trouble and there won't be much difficulty in getting the right inhibitor. There is some question as to whether an inhibitor is needed.

I know some people think that an inhibitor like triethanolamine acts as an inhibitor to prevent decomposition of the esters and other materials. Others think that materials like the MEA coat the metal walls so that you have a film on the walls to prevent corrosion. Others, I know, think that they just act to neutralize any acidic decomposition products.

But, regardless of the way they work, a variety has been used such as triethanolamine, monoethanolamine, and one that hasn't been mentioned is the sodium naphthenate, which usually has some excess free caustic in it. Then you will recall that back during the war even ammonia was used, so that in many of the units now, it is not a serious problem at all. In most of the newer units it isn't, so one way to get away from the fouling and corrosion is to improve the operations so that you're making high-quality products and experiencing low acid consumption.

BYRNE: We were using Cronox 1110A and Nalco 161 with good corrosion protection. However, we have encountered something perhaps a little unusual in that some of our gasoline streams where we have used Cronox 1110A did give us emulsions in a dilute caustic prewash in our treaters. We had to change over to Nalco 161 there to get out of the emulsion troubles.

It is interesting to note, though, that on a recent inspection one of the condensers that had been protected by 1110A and is now protected by Nalco 161 did show more fouling than previously. Perhaps that is in line with the detergent properties of Cronox as compared with Nalco.

NOTE: Three succeeding articles in The Oil and Gas Journal will deal with cat cracking, cat reforming, alkylation, and miscellaneous problems. The articles are based on a panel discussion at the Western Petroleum Refiner's Association regional meeting at El Dorado, Ark.

Air agitation in primary-solution drum can help keep a

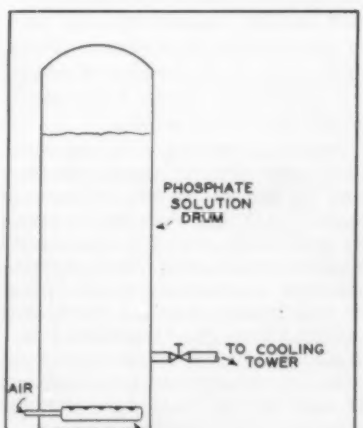
Uniform phosphate mix

A UNIFORM phosphate concentration can be maintained by agitating contents of the primary solution drum with air.

Phosphate addition to cooling water serves to inhibit corrosion and prevent scale from hardening on equipment. However, when phosphate concentration is increased, excessive scaling is the result. Hence, it is quite desirable to insure that phosphate concentration is held at the proper level, between 10-15 p.p.m.

Crystalline phosphates are usually dissolved in water in the solution storage drum. The phosphate solution is then added to the cooling-tower water by drawing on this storage drum at a predetermined rate. However, it is quite difficult to get a uniform phosphate addition rate under these conditions since the phosphate concentration within the drum varies a great deal. Tests made show that the concentration at the top amounted to about 1.7 weight per cent while that at the bottom amounted to 8.8 weight per cent.

An air ring installed on the bottom of the drum will eliminate this condition. Air injected through the ring provides enough agitation to mix the contents of the drum and insure a uniform concentration throughout it.



PHOSPHATE solution drawn to cooling tower would be of uneven strength if air ring at bottom did not agitate solution.

Method suggested by Roy E. Wolcott, operator; courtesy Humble Oil & Refining Co., Baytown, Tex.

How to get the Most hole for your money

PART 1

The author calls this study a "method for determining optimum drilling techniques," and presents a studious report on how to get best performance and cheapest hole

BY JOHN W. SPEER

HERE IS A simple method for determining the combination of weight on bit, rotary speed, and hydraulic horsepower which produces minimum drilling cost. Empirical relationships are developed to show the influence on penetration rate of weight on bit, rotary speed, and hydraulic horsepower. Optimum weight on bit is shown in relation to formation drillability, and optimum rotary speed is related to weight on bit. These five relationships are then combined into a chart for determining optimum drilling techniques from a minimum of field test data.

Secondary issues discussed are: (1) Advantages of the jet bit over the regular bit and minimum nozzle fluid velocity requirements for jet-bit use relative to formation drillability; and (2) distribution of pump horsepower into nozzle fluid velocity and circulating volume.

Drill-bit performance depends primarily upon the five controllable factors: (1) Weight on bit, (2) rate of rotation, (3) hydraulic horsepower, (4) type of bit, and (5) properties of the circulating medium. Although each parameter contributes individually to bit performance, they are closely interrelated and their combined influence governs the degree of drilling efficiency obtained. In particular, an attempt will be made here to find answers for the following:

1. How penetration rate of a bit varies with weight on bit, rate of rotation, and hydraulic horsepower.
2. To what upper limits these parameters can be carried economically.
3. The interrelation of these three parameters in various formations, and the combinations which result in minimum drilling costs.
4. Merits of various types of bits.

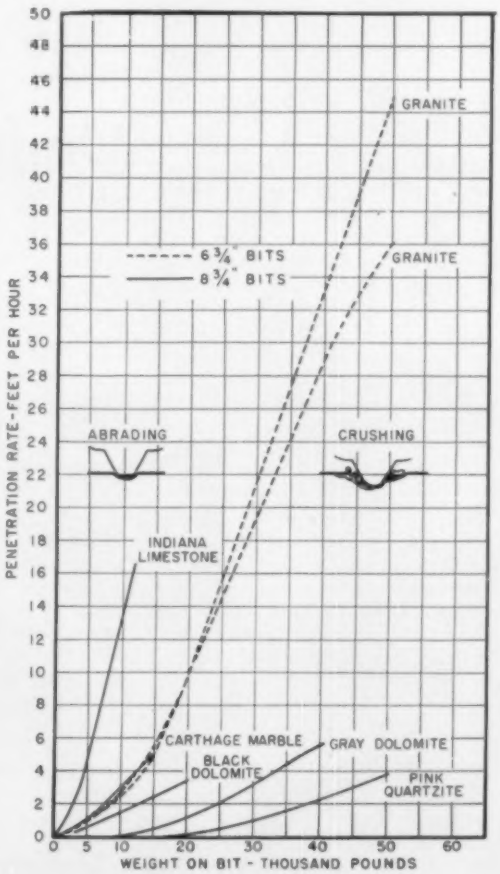
There are, of course, many factors other than the five discussed here that affect drilling efficiency and footage costs. These include formation hardness, abrasiveness of formation, well depth, and many others. As these items cannot be conveniently controlled, their influence on costs must simply be accepted. The purpose here is to determine how the so-called controllable parameters can be varied to produce minimum costs under whatever drilling conditions are encountered.

The author is with Shell Oil Co. at New Orleans. Paper presented at spring meeting, API Production Division, southern district, New Orleans, under the original title, "A Method for Determining Optimum Drilling Techniques."

Influence of Factors on Bit Performance

Weight on bit vs. penetration rate . . . Laboratory data and field results are available for study of the effect of weight on bit on penetration rate. Because of the mechanics of test apparatus most laboratory data are obtained from the harder, more brittle rocks, some of which are not normally penetrated in oil-field work. On the other hand, laboratory experiments are more easily controlled than field tests, and results contain less interference from other factors, such as lack of bottom-hole scavaging and variations in rock properties. The two types of data appear to correlate well if properties of the rocks are considered.

The laboratory data which indicate the relationship between weight on bit and penetration rate are shown graphically in Fig. 1. These data were obtained with 8¾ and 6¾-in. roller bits, from rocks varying in hardness from limestone to pink quartzite.[1,2] The character of all of the curves is similar. Beginning at the O, O ordinate or origin of the graph: (1) Penetration rate responds only slightly to increases in weight in the low-weight range; (2) a weight is reached where response of penetration rate begins to increase



PENETRATION RATE vs. weight on bit—laboratory data. Fig. 1.

rapidly; and finally, (3) the response of penetration rate to increases in weight becomes constant and a linear relationship develops.

In Condition 1 within the low-weight range, load on the bit teeth presumably does not exceed the compressive strength of the rock and drilling progress results from wear and minor crushing on the surface. (See inset, Fig. 1.) Condition 2 is the weight range in which the compressive strength of the rock is exceeded, and the teeth begin to chisel in and fracture out large pieces of rock. This weight is often called "critical weight." Condition 3 is the weight range in which the compressive strength of the rock has been exceeded, and depth of penetration of the bit teeth depends upon weight. The one major variation between the curves for the different rocks is "critical weight," which increases with hardness or strength of the rock.

Now let us examine in the light of oil-field drilling the materials from which these results were obtained. Limestone is classified "hard" to "very hard," but still comprises a major part of total footage drilled. Dolomite is usually classified "very hard," and with cherts and silicious limestones, comprises only a small percentage of oil-field drilling. Granites, marble, and pink quartzite are very seldom drilled. Thus, considering the two materials pertinent to oil-field drilling, critical weights are low and straight-line relationships between weight and penetration rate are reached at low weights. Further, if the results in the low-weight range are ignored and the straight-line sections of the curves extended downward, they intersect the base of the graph only slightly to the right of the origin. For example, the extended curve for limestone, which is among the harder rocks normally drilled in the field, passes only 2,500 lb. to the right of the origin.

Therefore, it appears from laboratory data that penetration rate varies approximately in a direct proportion with weight on bit for materials usually penetrated in oil-field drilling. For the hard, brittle rocks, the relationships for weight ranges pertinent to field practices are also linear, but the intersections of the extrapolated curves with the base of the graph are to the right of the origin.

Field results which indicate the effect of weight on bit on penetration rate are shown graphically in Fig. 2. These results were obtained from several areas and represent a variety of formations, bit sizes and types, and hole conditions as related to circulating-fluid volumes.[3 4 5 5a] Each set of data is intended to show only influence of weight on bit, as all other variables such as formation, rotary speed, bit type, circulating rate, etc., were supposedly held constant. To assist in analyzing the data, the O, O ordinate or origin of the graph can be considered a point on each curve because penetration rate would be zero at zero weight.

Also, some consideration can be given the fact that lack of adequate bottom-hole scavaging depresses the effect of weight on bit. As this latter phenomenon appears to influence much of the field data, it would be expedient to investigate it further before proceeding with the general analysis.

To demonstrate the influence of inadequate bottom-hole cleaning on bit performance, three curves of weight vs. penetration rate for various bit hydraulic horsepower are plotted in Fig. 3.[6] Referring to curve A, at the lower hydraulic horsepower balling up* starts at about 8,000-lb. weight, and the response of penetration rate to increase in weight begins to decrease. Balling up continues to increase with weight, and eventually a weight is reached (22,000 lb.) where further increase results in a decrease in penetration rate. By increasing hydraulic horsepower (curves B and C), balling up is deferred and a constant response of penetration rate maintained to a greater weight on bit.

Also evident is that the balling up of a bit can progress over a relative-

*This condition is often referred to as "balling up," although the terminology does not well describe the condition. Insufficient bottom-hole scavaging often results in reduced drilling efficiency because of regrinding or recutting of chips on the bottom of the hole, with no evidence of cuttings adhering to the bit as is inferred by the term "balling up." However, in the interest of space and uniformity, the term is used here to refer to any condition wherein lack of bottom-hole cleaning interferes with bit performance.

The author says . . .

1. Penetration rate of a rock bit varies approximately in direct proportion with weight on bit in formations normally penetrated in oil-field drilling, if sufficient circulating medium is provided to maintain clean bottom-hole conditions.

2. Optimum weight on bit, or the weight which results in minimum footage cost, varies inversely with formation drillability. It appears that an approximate relationship between optimum weight on bit and penetration rate can be developed.

3. Penetration rate of a rock bit under laboratory-test conditions varies in direct proportion with speed of rotation.

4. Penetration rate of a rock bit under field-operation conditions varies in a decreasing function with rate of rotation; i.e., the response of penetration rate to increases in rotary speed decreases as rotary speed is increased.

5. It appears that optimum rotary speed, or the rotary speed which results in minimum cost, varies inversely with weight on bit, and an approximate relationship between weight on bit and optimum rotary speed can be developed.

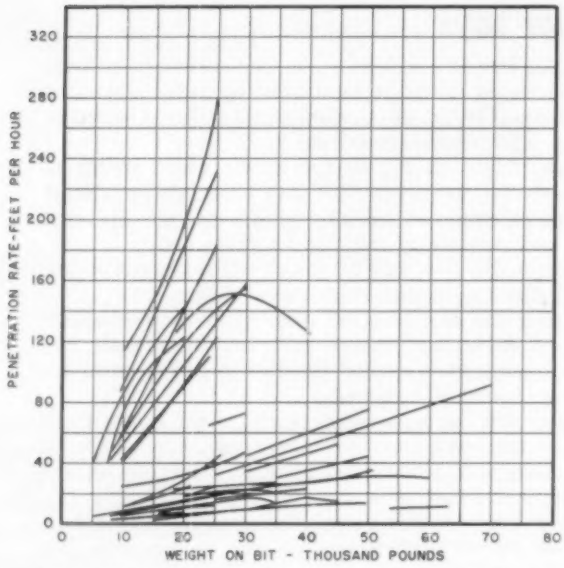
6. Hydraulic horsepower required for optimum bottom-hole scavaging varies lineally with weight on bit; consequently, hydraulic horsepower requirements vary lineally with penetration rate in any specific formation.

7. The advantage in drilling efficiency of the jet bit over the regular bit is a minimum in medium-hard formations, and increases directly with softness of formations. (Also, the advantage of the jet bit appears to increase directly with hardness of formation from medium hard to the very hard; however, this is substantiated by meager data.)

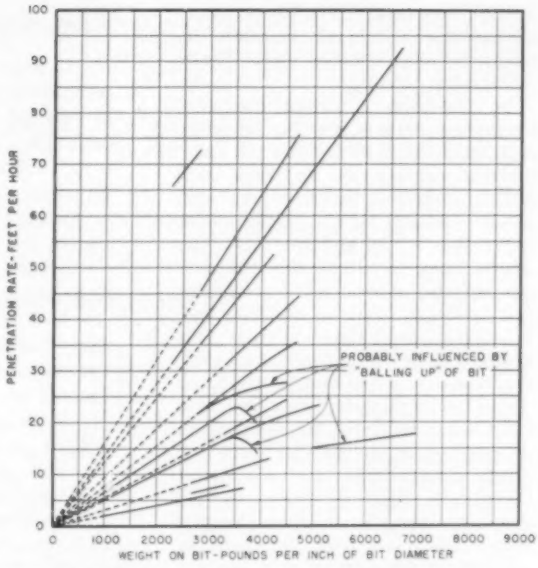
8. Minimum nozzle fluid velocity for effective jet-bit application varies from 170± ft. per second in soft formations to 225± ft. per second in medium-hard formations.

9. The three-cone regular bit performs better than the cross-section regular bit.

10. By combining the relationships between (1) penetration rate and hydraulic horsepower; (2) penetration rate and weight on bit; (3) optimum weight on bit and penetration rate; and (4) optimum rotary speed and weight on bit, a method for predicting approximate optimum drilling techniques can be developed.



PENETRATION RATE vs. weight on bit—assorted field data. Fig. 2.



RELATIONSHIP between rate of penetration and weight per inch of bit diameter—field results. Fig. 4.

ly large weight range. For this reason, its initial stages are difficult to detect, and much oil-field drilling is done with a partially balled-up bit. In fact, over-all bit performance usually can be improved in the field by increasing weight into the partially balled-up region. Field test results covering only part of the pertinent weight range, such as much of that plotted in Fig. 2, could show any relationship from directly proportional to inversely proportional, depending on the degree of balling up involved.

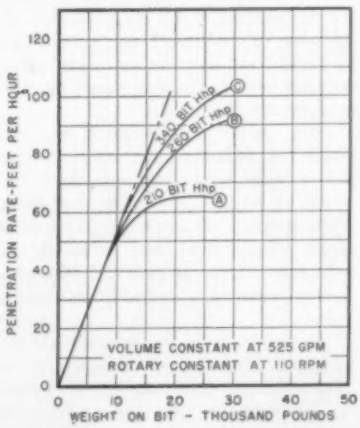
Thus, all of the curves in Fig. 2 can be expected to pass through the origin of the graph, and some data can be expected to show a smaller-than-actual response of penetration rate because of balling up. Actually, four basic types of curves or relationships are indicated following:

1. **Curves that bend upward, and could pass through the origin only with a reversal in slope (three curves—9% of total curves).** There is not an apparent reason for a reversal in slope for a relationship of this nature, and it is presumed that this relatively small group of data reflects the effect of other factors, such as variation in rock hardness.

2. **Curves that bend upward, and would pass through the origin if extrapolated downward (five curves—15% of total curves).** This relationship is quite reasonable, particularly for "hard rock," as shown by laboratory results. The occurrence is small (15%), however, and the data are interspersed throughout the range of drillability and do not appear to represent a particular type of formation.

3. **Curves that bend downward, and could pass through the origin without reversal in slope (nine curves—27% of total curves).** As these curves could logically intersect the origin of the graph, this type of relationship cannot be entirely discounted. It was anticipated, however, because with inadequate bottom-hole cleaning and balling up, it can be duplicated in any formation. Therefore, for the moment, it is assumed that these results reflect insufficient bottom-hole cleaning.

4. **Curves that are straight lines, and approximately pass through the origin (16 curves—49% of total curves).** This relationship is indicated by the largest group of data and is also the relationship most commensurate with laboratory results.

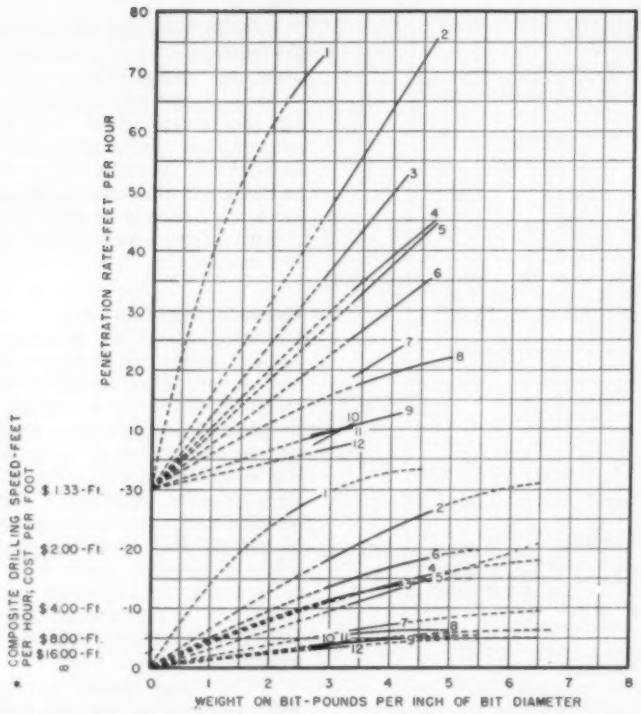


INFLUENCE of lack of hydraulic horsepower or "balling up" on penetration rate (taken from Reference 6). Fig. 3.

Returning to the field data analysis: (1) approximately one-eighth of these results appear illogical; (2) approximately one-eighth of the results indicate an increasing response of penetration rate to increases in weight, and although quite feasible in view of laboratory data, they are discounted because of the small occurrence; (3) approximately one-quarter of the results appear to reflect the influence of lack of adequate bottom-hole scavaging, and are discounted for this reason; (4) about one-half of the results indicate that penetration rate varies in direct proportion with weight on bit.

It is concluded that penetration rate varies approximately in a direct proportion with weight on bit in formations normally penetrated in oil-field drilling if sufficient fluid circulation is provided to insure clean bottom-hole conditions. The relationships for the many formations encountered in oil-field drilling could then be approximately represented graphically by a family of straight lines emanating from the origin of the graph.

The magnitude of the weights involved in Fig. 2 are more clearly shown in Fig. 4, where penetration rate is plotted as a function of weight expressed in pounds per inch of bit diameter. These are data from Fig. 2 for which bit size and other pertinent information were recorded, and are also, in general, results from the most closely controlled tests and should contain less interference from factors other than weight. In Fig. 4, a definite directly proportional rela-



EFFECT OF WEIGHT ON BIT on penetration rate and footage cost (Ventura, Calif., and Denton, Tex). Fig. 5.

$$\text{Footage} = \frac{}{\text{Rotating hours + round-trip hours + rig hours equivalent to bit cost}}$$

tionship between weight and penetration rate is indicated. Balling up is clearly evident, and usually follows a weight range in which penetration rate responded at a constant rate to increases in weight. Most of the data are for weights up to 4,500 lb. per inch of bit diameter. Two groups include weights of 6,500 and 7,000 lb. per inch, one of which indicates probable interference from lack of hydraulic horsepower.

Within these weights there is indication that the bit teeth were completely buried, a condition which might be expected if weight were increased far enough (assuming bit would withstand load). If this occurred, penetration rate probably would not increase further with increases in weight, but also probably would not decrease appreciably as it does when balling up becomes the deciding factor.

Weight on bit expressed as pounds per inch of bit diameter (p.i.b.d.) is not a completely satisfactory unit for describing operating conditions, particularly if applied to all bit sizes in use. However, it appears to be the unit best suited to this study. It has been shown that bearing capacity of a bit decreases more rapidly than bit diameter, and also that volume of tooth metal decreases more rapidly than hole area.[7] It would follow then that smaller bits are not as competent as larger bits. Further, penetration rate varies directly with bit diameter, even with equal weights per inch of bit diameter. However, within the range of bit sizes normally used (6 in. to 12¼ in.), optimum or most economical weight (p.i.b.d.) does not appear to vary appreciably with bit size. Therefore, inasmuch as optimum conditions are the primary concern of this report, p.i.b.d. is deemed a satisfactory unit for use in characterizing over-all drilling performance.

Weight vs. footage cost . . . Penetration rate is one of five units which comprise footage cost; the other four are: (1) bit life (hours); (2) time required to put a new bit on bottom (round-trip time); (3) bit cost; and (4) hourly rig cost, as follows:

$$\text{Footage cost} = \frac{C\,(L + T) + B}{L \times R}$$

Where:

R = penetration rate, ft. per hour
L = bit life, hours
C = rig cost, dollars per hour
T = trip time, hours
B = bit cost, dollars
L × R = footage per bit

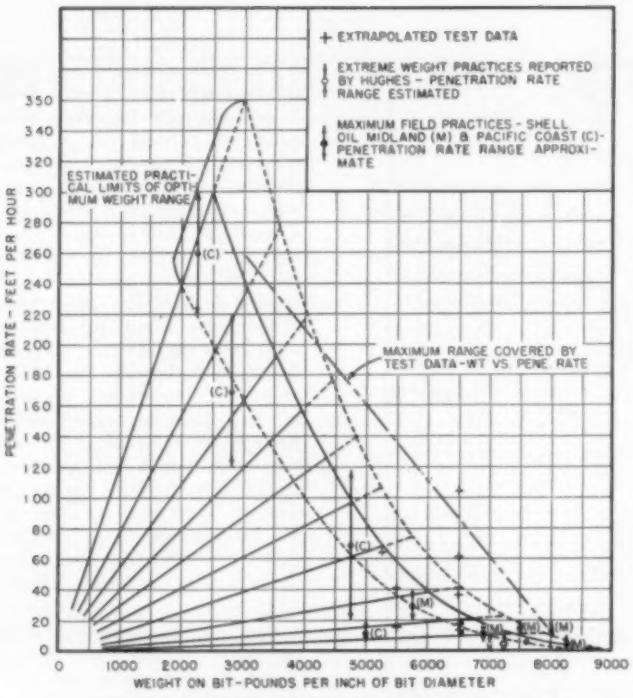
The three units, rig cost, trip time, and bit cost are fixed for a given condition, and only the effect of weight on the life of a bit and on penetration rate are of primary interest. That penetration rate varies proportionally with weight has been concluded. And it would therefore appear possible to drill all formations at approximately the same speed if enough weight were applied to bury the cutter teeth. Obviously, this is not practical because such loads would cause immediate bit failure in the harder formations. Thus, to obtain a complete understanding of the effect of weight on bit on footage cost is necessary to determine the weight which results in minimum drilling cost as well as the relationship between cost and weight over the total weight range (weight which results in minimum cost is hereafter referred to as optimum weight).

In order to use this information to predict weight practices without exhaustive testing, it is necessary to correlate optimum weight with some readily measurable formation quantity or index. Fortunately, drillability* or penetration per unit of weight p.i.b.d., which is a formation index easily measured, appears to be a satisfactory unit.

Shown in Fig. 5 are 12 sets of data which indicate the relationship between footage cost and weight on bit. To demonstrate that lack of bottom-hole cleaning did not interfere with cost results, penetration rate as a function of weight is also shown for each set of data. The character of all of the cost curves are similar, downward bending indicating a decreasing response of cost to increases in weight on bit, which also demonstrates that an optimum weight for minimum cost exists for each drilling condition. Although all of these curves must be extrapolated much too far for accuracy in order to demonstrate optimum weight, it is worth while to note two items: (1) optimum weight appears to decrease slightly as the formations become softer (and penetration rates increase); (2) optimum weights appear to be in the order of 5,500 to 6,500 p.i.b.d. for these medium-hard formations.

Curve 8 demonstrates the depressing effect of lack of adequate bottom-hole scavaging or balling up on maximum economical weight. That penetration rate did not respond directly with weight (upper curve 8) indicates that lack of scavaging influenced results, and consequently, maximum

*Drillability refers to the drilling property: $\frac{\text{penetration rate}}{\text{p.i.b.d.}}$; or slope of weight vs. penetration-rate curve.


+ EXTRAPOLATED TEST DATA
EXTREME WEIGHT PRACTICES REPORTED BY HUGHES – PENETRATION RATE RANGE ESTIMATED
MAXIMUM FIELD PRACTICES – SHELL OIL, MIDLAND (M) & PACIFIC COAST (C) – PENETRATION RATE RANGE APPROXIMATE
ESTIMATED PRACTICAL LIMITS OF OPTIMUM WEIGHT RANGE
MAXIMUM RANGE COVERED BY TEST DATA – WT VS. PENE. RATE
PENETRATION RATE – FEET PER HOUR
WEIGHT ON BIT – POUNDS PER INCH OF BIT DIAMETER

WEIGHT-ON-BIT FOR MOST ECONOMICAL COST VERSUS FORMATION DRILLABILITY *

WEIGHT ON BIT for most economical cost vs. formation drillability.* (All curves predicated on basis sufficient hydraulic horsepower available to insure clean bottom-hole condition). **Fig. 6.**

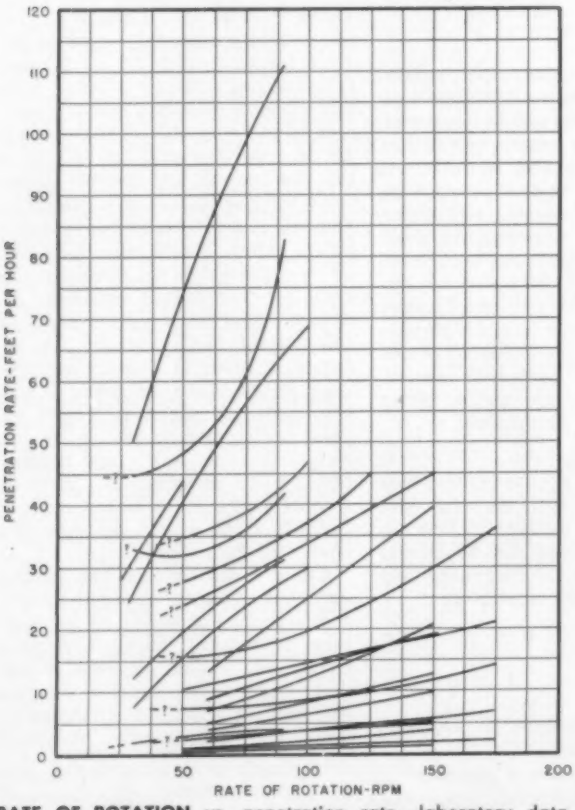
$$*\text{Drillability} \propto \frac{\text{Penetration rate}}{\text{Weight}}$$

weight was reduced about 2,000 p.i.b.d. to 4,500 p.i.b.d. (lower curve 8).

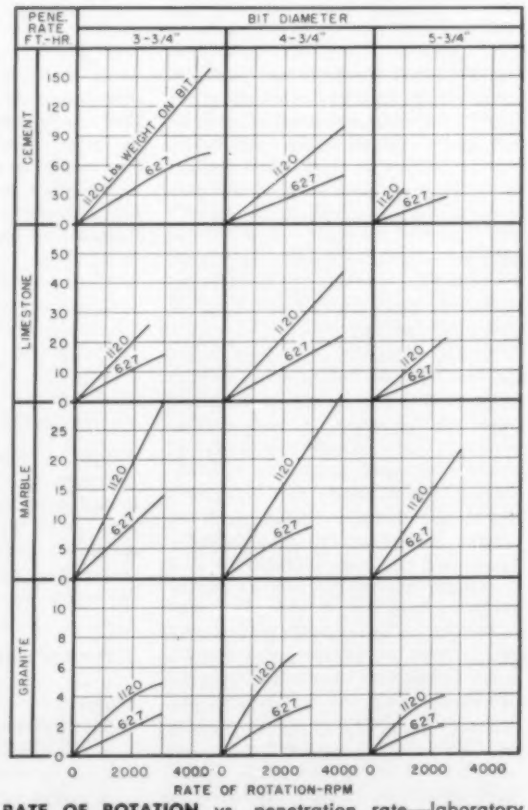
Another important characteristic of the cost curves to be noted for future use is that change in slope appears to be gradual, and optimum weight does not appear too critical. This will be advantageous when attempting later to establish optimum weight on bit as a function of formation drillability, for a large margin of error is incorporated in the characteristics of the cost curves.

Optimum weight on bit . . . Thus, it appears that there is a maximum economical weight for each type of formation penetrated; to determine that weight for the varied formations penetrated in oil-field drilling is the principal problem. This is attempted in Fig. 6. Shown in Fig. 6 are relationships between penetration rate and weight on bit, represented by a family of straight lines emanating from the origin of the graph, and a curve which is intended to represent optimum weight as a function of formation drillability. This latter curve was constructed as follows:

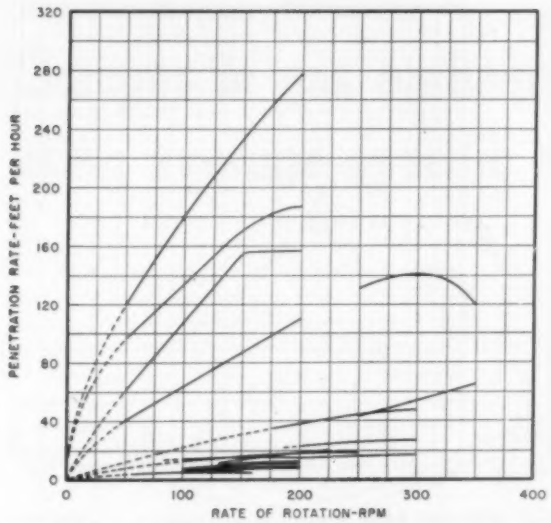
1. Field test results, and general field practices indicate that optimum weight decreases as formations become softer (drillability increases). There-



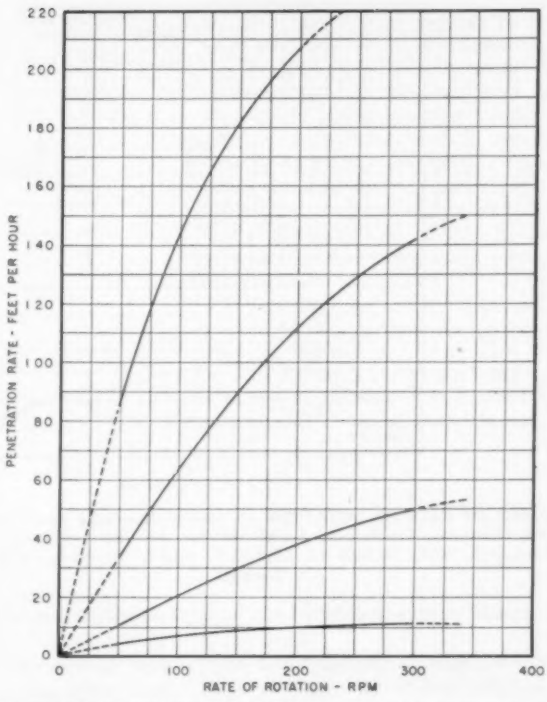
RATE OF ROTATION vs. penetration rate—laboratory data. (Hughes and Reed Labs.). **Fig. 7.**



RATE OF ROTATION vs. penetration rate—laboratory data. (Various bit sizes, loads, and materials; Russian laboratory). **Fig. 8.**



PENETRATION RATE vs. rate of rotation—assorted field data. Fig. 9.



EFFECT OF SPEED OF ROTATION on rate of penetration—composite of field data. Fig. 10.

fore, the general direction of the curve is known.

2. The placement of the curve on the graph was estimated from field test results (extrapolated), general field practices from Pacific Coast and Permian basin, and extreme weight practices for various areas as reported by Hughes.[1] Recognizing the inaccuracy which could be incurred in extrapolating field test results, they were not weighted heavily in construction of the curve. General field practices (reported by Hughes) are usually found to be slightly lower than optimum weight because several field problems, such as hole deviation, restrict weight for reasons other than bit life; therefore, the curve was made to pass slightly above these points. Likewise, Pacific Coast practices are known to be slightly lower than optimum because of deviation problems, and these values were treated similarly. Permian basin practices are relatively free of interference from other problems, and weight practices are governed primarily by footage cost; therefore, the curve was made to pass through these points.

In addition, a range of weights within which near-minimum footage cost should result was incorporated in the graph because field test results indicate that within a range of 2,000± p.i.b.d. encompassing optimum weight, costs do not vary appreciably, and because it is recognized that a finite optimum-weight curve cannot be constructed with the information available.

The function of this **tentative curve** of optimum weight vs. formation drillability is in estimating the weight which would result in minimum footage cost, after the penetration-rate index of the formation has been established. It is intended that this estimated weight would produce near-minimum costs, so that drilling operations could be raised to a high degree of efficiency quite rapidly. As time permitted, variations in weight practices could be made through field testing in order to obtain 100% efficiency.

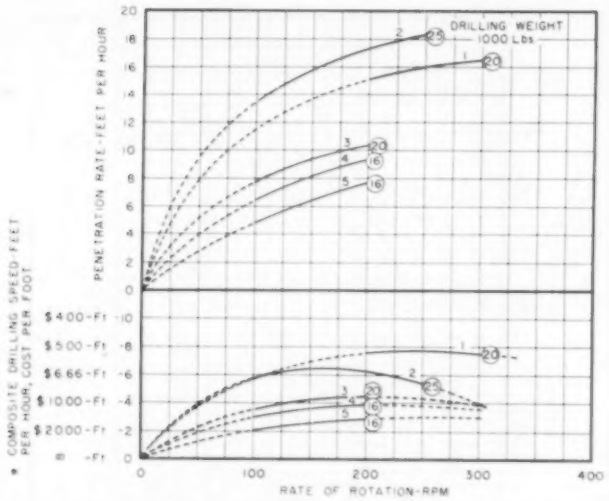
Because these curves require that sufficient hydraulic horsepower is available to maintain clean bottom-hole conditions, field application of the graph presented in Fig. 6 can best be demonstrated in conjunction with the other variables which affect drilling efficiency. For this reason, its function will be discussed further in the last section of this report.

Rotary speed vs. penetration rate . . . Laboratory data and field results are available for study of the effect of speed of rotation on penetration rate; however, the data do not correlate well. Laboratory results indicate that penetration rate increases directly with speed of rotation, whereas field results indicate a decreasing response of penetration rate as rotary speed is increased. Possibly, instability associated with a long string, and/or lack of bottom-hole scavaging ahead of the cutters account for the difference. At any rate, it is necessary to make a choice between the two relationships, and field results are considered more appropriate for this study.

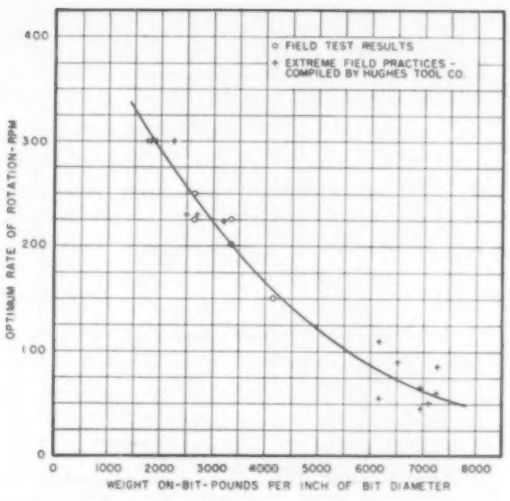
Laboratory results which indicate the relationship between rate of rotation and penetration rate are shown graphically in Fig. 7.[2] To assist in analyzing the results, the origin of the graph can be considered a point on each curve, because penetration rate would be zero with no rotation.

Basically, three types of curves or relationships are represented: (1) Straight-line curves emanating from the origin of the graph, showing directly proportional response of penetration rate to increases of rotary speed; (2) curves that bend slightly upward, showing increasing response of penetration rate to increases of rotary speed; (3) curves that bend slightly downward, showing decreasing response of penetration rate to increases of rotary speed. Although an average of these results indicates that penetration rate varies in a direct proportion with speed of rotation, the data are too inconsistent to be conclusive.

Laboratory data obtained from a Russian report and reproduced in Fig. 8 are more consistent and show a greater range of rotary speeds.[8] The data were obtained from bit sizes of 3¾, 4¾, and 5¾ in., and for formations of cement, limestone, marble, and granite. Results are also for two bit loads, 1,120 lb. and 627 lb. Considering the three softer forma-



EFFECT OF RATE OF ROTATION on penetration rate and footage cost (Ventura, California, field; various drilling weights; 6-in., three-cone bits; 10,000 to 12,000-ft. depth intervals. Fig. 11.


FIELD TEST RESULTS
EXTREME FIELD PRACTICES - COMPILED BY HUGHES TOOL CO.
OPTIMUM RATE OF ROTATION-RPM
WEIGHT ON-BIT-POUNDS PER INCH OF BIT DIAMETER

OPTIMUM RATE of rotation as a function of weight on bit. Fig. 12.

$$\text{Footage} = \frac{}{\text{Rotating hours} + \text{round-trip hours} + \text{rig hours equivalent to bit cost}}$$

tions—cement, limestone, and marble—penetration rate varies in a direct proportion with rotary speeds to as great as 4,500 r.p.m. In the harder granite, the response of penetration rate decreases slightly as rotary speed is increased. It was surmised that this occurred because the harder rock caused more vertical vibration of the bit, and thereby reduced drilling efficiency.

Field results which indicate the relationship between rate of rotation and penetration rate are shown graphically in Fig. 9.[3] Again, the origin can be considered a point on each curve. **Only one relationship is consistently indicated; the response of penetration rate decreases as rotary speed is increased (16 of the 18 sets of data produce curves that bend downward).**

Referring to Fig. 10 where curves representative of averages of these field data are plotted, it appears that a rotary speed might eventually be reached where further increase would not produce an increase in penetration rate. It also appears that this "maximum rotary speed" decreases as formation hardness increases. For example, maximum penetration rate might be achieved at 300± r.p.m. in formations that drill to about 10± ft. per hour, whereas some speed greater than 400 r.p.m. would be required to obtain maximum penetration rate in formations that drill at 160± ft. per hour.

Rotary speed vs. footage cost . . . Because rotary speed affects bit life, as well as penetration rate, the ultimate criterion for its evaluation must be footage cost just as with weight on bit.

Plotted in Fig. 11 are the few field results available which indicate the effect of rotary speed on drilling cost. Also shown on the graph is the relationship between penetration rate and rotary speed for each group of data. Three indications are worthy of mention: (1) the responses of penetration rate to rotary speed are commensurate with the general relationships shown by other field data (Fig. 9); (2) all cost curves bend downward and indicate an optimum rotary speed well within the mechanical abilities of most rigs (optimum rotary speed refers to the rotary speed which results in minimum cost); (3) optimum rotary speed appears to decrease with increase in weight on bit. For example, an optimum rotary speed of about 150 r.p.m. is indicated when using 25,000 lb. on a 6-in. bit, and about 225 r.p.m. is indicated to be optimum when using 20,000 lb. (curves 1 and 2). There is also a slight indication from comparison of curves 1 and 3 that optimum rotary speed decreases as formation hardness increases. It is also noted that optimum rotary speed is not too critical, but encompasses a range of about 50 r.p.m.

Optimum rotary speed . . . Summarizing briefly:

1. The response of penetration rate to variations in rotary speed appears to vary slightly with formation drillability.
2. Optimum rotary speed appears to decrease as weight on bit is increased.
3. Weight on bit usually is increased with hardness of the formation.
4. Weight on bit appears to be more influential than rotary speed (directly proportional relationship with penetration rate).

In view of this, it was deemed advisable to relate optimum speed of rotation to weight on bit for the purpose of obtaining a method for predicting optimum drilling techniques, because weight appears to influence optimum rotary speed more than formation hardness. This is attempted in Fig. 12 through the use of field test results, and general field practices compiled by Hughes Tool Co.[1] Field test results are plotted directly from Fig. 11. The Hughes data consist of a compilation of general weight and r.p.m. practices used throughout the United States for large groups of operators. Data plotted in Fig. 12 represent extreme practices, but as they are for large groups of operators, they are presumed to be well within the economical operating range of rock bits. The reliability of the curve is strengthened somewhat by the close correlation between test data and general field practices.

Thus, the curve shown in Fig. 12 embodying both field test results and extreme field practices is intended to represent the approximate relationship between optimum rotary speed and weight on bit. Again it is pointed out that optimum rotary speed is not too critical, but encompasses a range of about 50 r.p.m. Nevertheless, the curve must be considered tentative until many more data are accumulated to more definitely establish its limits.

ELEMENTS OF FIELD PROCESSING—49

Changes in gas enthalpy using average specific heat

DR. JOHN M. CAMPBELL
University of Oklahoma

DETERMINATION of the changes in gas enthalpy is an essential part of the calculations involved in the heating or cooling, and compression or expansion of natural gas. There are three basic means available to determine enthalpy: (1) use of average specific heats, (2) nomographs correlating enthalpy, and (3) use of enthalpy-entropy or enthalpy-pressure (Mollier) diagrams. Which of these is used depends on convenience and process characteristics.

Where the gas is being only heated or cooled at substantially constant pressure, the use of average heat capacities is usually convenient and satisfactory. Equation 1 (Part 48) may be written as

$$\Delta H = Cp_a (T_2 - T_1) \qquad (1)$$

for a substantially constant-pressure process

where

ΔH = enthalpy change — B.t.u per lb.
Cp_a = specific heat — B.t.u. per lb. —°F. at temperature $T_2 + T_1/2$
T_2 = final temperature — °F.
T_1 = initial temperature — °F.

Equation 1 may be multiplied by the gas flow rate in pounds per hour to arrive at the total heat transferred in B.t.u. per hour. A convenient equation for converting from volume to pounds per hour is shown in Part 46.

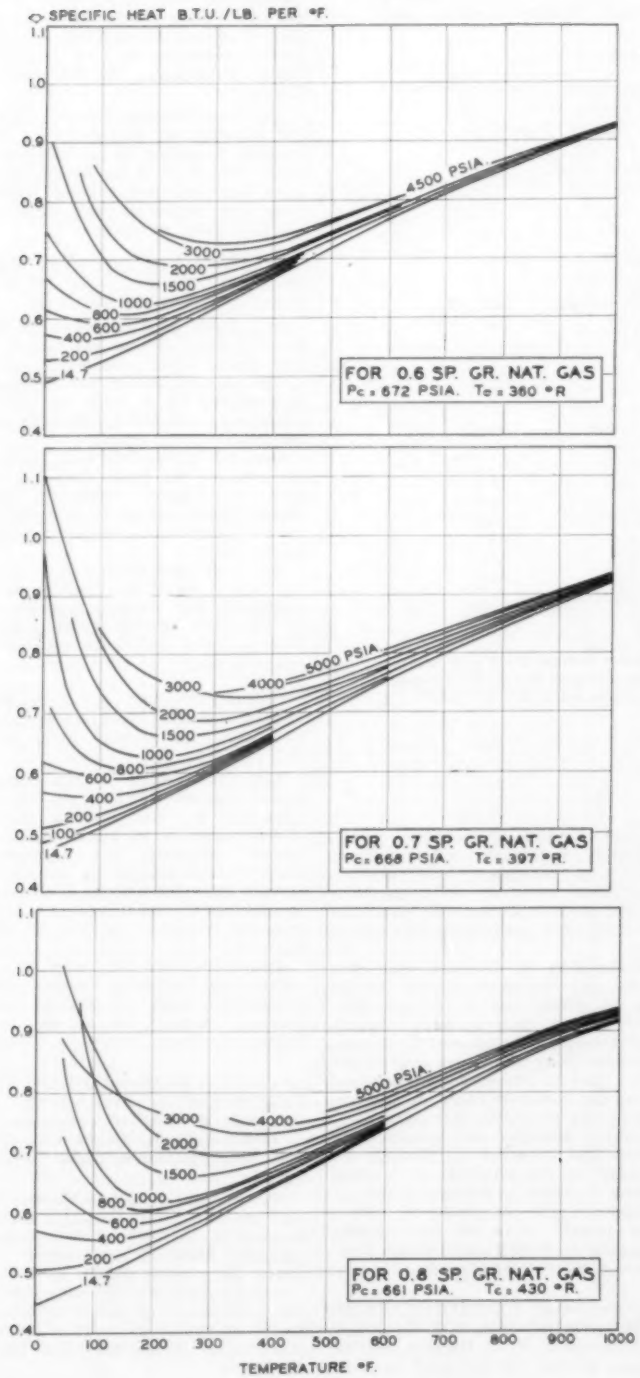
Fig. 1 shows average specific heat as a function of average temperature, pressure and gas specific gravity.

NOTE: Fig. 1 was inadvertently omitted from Part 48 of this series, which appeared in the Journal issue of February 17, page 111. The figure appears at the end of this article.

These charts are easy to use and are accurate enough for most lease processing applications.

Another approach is to determine the specific heat of the gas at atmospheric pressure and then correct the value obtained for pressure, using general correlations based on reduced temperature and pressure.[1] The specific heat of gas at atmospheric conditions may be determined from several sources.[2,3]

The use of Fig. 1 may be illustrated by the following example:



AVERAGE specific heat of natural gas is a function of temperature, pressure, and gas specific gravity. Fig. 1.

Example: 100 M.c.f. per hour of 0.6 sp. gr. natural gas are being heated from 90° to 180°F. in a heater to prevent hydrate formation. The average pressure is 800 psig. Determine the amount of heat that must be transferred to the gas in B.t.u. per hour.

Solution: The average temperature is 135° F. From Fig. 1, the specific heat is 0.63 B.t.u. per lb.—°F.

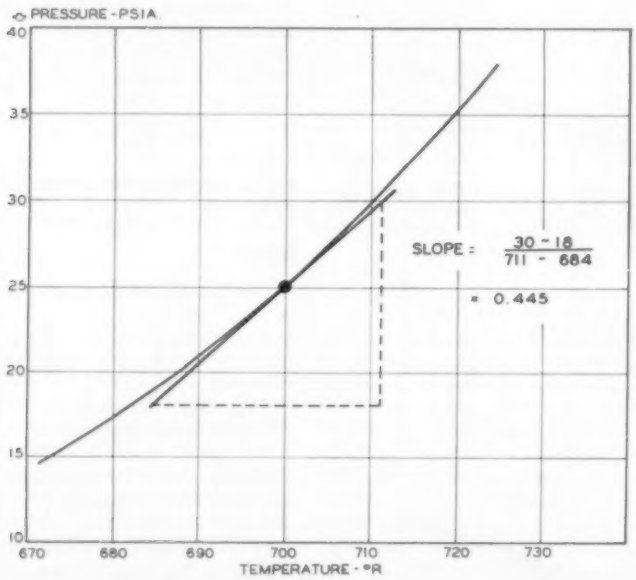
Lb. gas/hr. = (76.4) (0.6) (100) = **4580** (Part 46).

$\therefore \Delta H = (4580)\ (0.63)\ (180—90) = 260{,}000$ B.t.u./hr.

Bibliography

1. Weiss, A. H. and Joseph Joffe, Ind. Eng. Chem., 49, No. 1 (1957), 120.
2. NGSMA Handbook, Published by Natural Gasoline Association of America, (1951).
3. Bauer, C. R. and John F. Middleton, Petr. Ref., 32, No. 1 (1953), 111.

Here is Fig. 1, Part 48, of Elements of Field Processing, which was inadvertently omitted.



SLOPE OF THE CURVE, vapor pressure versus temperature for water, is determined by drawing a tangent to the curve at the desired point. At a pressure of 25 psia. and a temperature of 700° R. (240° F.) the slope is seen to be 0.445.

BOOKS

TULSA GEOLOGICAL SOCIETY DIGEST, Vol. 25, 1957. Published by Tulsa Geological Society, Tulsa. 222 pp.

The annual digest of the Tulsa Geological Society contains papers on recent geological research and phenomena, new frontiers of petroleum exploration, the geology of important oil fields and areas of local interest, and the present status of Middle East oil. In addition, the digest contains a bibliographic index to geological theses from Oklahoma universities. Some of these theses are the only basic literature available on "new areas.

PLANT DESIGN AND ECONOMICS FOR CHEMICAL ENGINEERS. By Max S. Peters. Published by McGraw-Hill Book Co., 330 West 42nd. Street. New York 36, New York. 511 pp., $11.00.

This book presents a comprehensive coverage of economic and design principles as applied in industrial operations and processes. The essential combination of economic analyses with plant-design considerations is emphasized throughout.

The first part deals with applied economics, particularly in the process industries and in design work. The various costs involved in industrial processes, capital investments and investment returns, cost estimation, cost accounting, optimum economic design methods, and other subjects dealing with economics are covered both qualitatively and quantitatively.

The remainder of the book deals with methods and important factors in the design of plants and equipment. Generalized subjects, such as waste disposal, structural design, and equipment fabrication, are included along with design methods for different types of process equipment. Basic cost data and cost correlations are also presented for use in making cost estimates.

Illustrative examples and sample problems are used extensively to illustrate the applications of the principles to practical situations. Problems at the end of most of the chapters give the reader a chance to test himself as to his understanding of the material. Several major design problems are included in the appendix.

OIL AND GAS DEVELOPMENTS IN KANSAS DURING 1956. By E. D. Goebel, A. L. Hornbaker, P. L. Hilpman, and D. L. Beene. Bulletin 128 published by State Geological Survey of Kansas, University of Kansas Publications, Lawrence. 250 pp.

This is a review of oil and gas drilling in the State of Kansas during 1956. A summary of the production is included, along with several valuable maps and charts. The importance of significant discoveries is discussed. Secondary recovery is becoming an important factor in Kansas crude production and now amounts to 10 per cent of the state's annual output.

SUBSURFACE CORRELATION AND STRATIGRAPHIC RELATION OF ROCKS OF MESOZOIC AGE IN KANSAS. By Daniel F. Merriam. Published by State Geological Survey of Kansas, Oil and Gas Investigations No. 14, University of Kansas Publications, University of Kansas, Lawrence.

The State Geological Survey of Kansas has provided oil geologists with a very valuable description of the Mesozoic rocks in the state. Each of the various formations is carefully described and the report contains three large-scale cross sections based on subsurface correlations.

BUILDING FOR INDUSTRY. Published by F. W. Dodge Corp., 119 W. 40th Street, New York, 18. 309 pages. $9.75.

In this new book are shown 74 separate projects from all over the United States, and several other countries as well.

The photographs of the buildings are accompanied by a series of informative studies on trends and factors in present-day industrial-building design.

Over 500 photographs and 200 drawings are used in the book. They are divided into six categories: warehouses, light industry, utilities and service industries, manufacturing laboratories, consumer goods, and heavy industry.

Each building is analyzed in detail, showing how it meets the practical need and policies of the company, explains choice of site, plan, lighting, colors, location of loading docks, rail spurs, employe facilities, and dozens of other features.

CATALYSIS—VOLUME 5. By Paul H. Emmett. Published by Reinhold Publishing Co., 430 Park Avenue, New York 22. 242 pp. $15.

This fifth volume in this outstanding series includes reactions of carbon monoxide, the oxo reaction, the direct catalytic synthesis of higher alcohols from carbon monoxide and hydrogen, the catalytic hydrogenation of aromatic compounds, hydrogen isotopes in the study of hydrogenation and exchange, and the hydrodesulfurization of liquid-petroleum fractions.

This book, together with the other volumes of the series, should prove of tremendous value to physical chemists, chemical engineers, and to men in every industry in which catalysis is involved.

COUNTERFLOW COOLING-TOWER PERFORMANCE. Published by J. F. Pritchard & Co. of California, 4625 Roanoke Parkway, Kansas City 12, Mo. Soft cover, perforated plastic binding. 85 pp. $3.

This manual is a compilation of the data necessary for an intelligent engineering estimate of size, general horsepower, and pumping head of counterflow cooling towers for a given duty.

This data can also be used to determine the performance of towers at other than design conditions as well as predict the performance of specific towers at given conditions.

BY W. L. NELSON, Technical Editor

Refinery Fuel Costs Throughout the World

THE VALUE of refinery fuel at any place is basically the value of Bunker C or residual fuel oil. Such fuel oil is usually sold in competition with Bunker C fuel from the Caribbean or Gulf Coast, or Middle East refineries. During 1955 (basis of Table 1) the price of Bunker C fuel was:

	Per bbl.
Gulf or Caribbean	$2.03
Persian Gulf	*2.03
Tampico, Mexico	2.11
West Coast, Mexico	2.29
San Pedro, Calif.	1.83
Singapore	3.10

*Usually considered as equal to Caribbean price, although actually sold at a higher price.

Approximate tanker rates (plain USMC) from these source points are indicated in Table 1, and the changes in the USMC rates since 1937 are indicated in Table 2. Table 1 also shows the approximate cost of fuel, and its cost relative to the cost of fuel in United States refineries (see Process Costimating No. 4, March 17, 1958, p. 190).

The value of fuel at any point can be estimated by adding the cost of transportation from the closest source of supply (corrected for the plus or minus of the U. S. Maritime Commission rate at that date) to the price of Bunker C fuel at the base point (usually the Caribbean area). Rates depend greatly on the length of the time charter being employed and are very low for company-owned vessels (What's the Average Cost . . .?, OGJ, Oct. 21, 1957, p. 134). The SCALE and USMC bases for stating tanker rates must not be confused with one another (SCALE and USMC Tanker Rates, OGJ, Aug. 20, 1956, p. 241).

Many countries have high import duties and other taxes to protect local refiners and unfortunately these taxes could not be incorporated in Table 1 because data were not adequate.

TABLE 1—STANDARD USMC RATES (CENTS PER BARREL) FOR TRANSPORTING FUEL OIL, AND AN INDICATION OF THE VALUE OF FUEL IN VARIOUS COUNTRIES.

Place or area—	Tanker rate* USMC $ per bbl.	Indication[6] of fuel value or cost (1955)‡ (approx.) $ per bbl.‡	Cents per million B.t.u.§	Rel. to av. USA cost¶
Africa (South)	[1]1.13	3.01	47.8	1.78
Alaska	[2]0.55	2.31	36.7	1.36
Argentina	1.05	[6]2.94	[6]46.7	[6]1.74
Austria	[5]1.28+1.20	4.34	68.9	2.56
Belgium	1.04	2.94	46.7	1.74
Bolivia	[5]0.83+1.40	[6]6.15	[6]97.7	[6]3.64
Brazil	0.86	[6 10]2.78	[6]44.1	[6]1.64
Canada	0.64	2.59	41.1	1.53
Ceylon	[1]0.38	2.36	37.5	1.39
Chile	0.99	[6]2.89	[6]45.9	[6]1.71
Colombia	0.21	[6]2.21	[6]35.1	[6]1.31
Cuba	0.33	2.32	36.8	1.37
Denmark	1.04	2.94	46.7	1.74
Dominican Republic	0.21	2.21	35.1	1.31
Ecuador	0.55	[6]2.51	[6]39.8	[6]1.48
Egypt	1.13	[6]3.01	[6]47.8	[6]1.78
France, N. Atlantic	1.04 [4](1.07)	[6]2.94	[9 6]46.7	[6]1.74
Finland	1.20	[7]3.07	48.8	1.81
Germany	1.04	2.94	[9]46.7	1.74
Greece	[1]1.16	[6]3.04	[6]48.3	[6]1.80
Hawaii	1.39	3.24	51.5	1.92
India	[1]0.85	2.77	44.0	1.64
Iraq	...	2.03	32.2	1.20
Iceland	1.02	2.92	46.3	1.73
Israel	[1]0.50	2.47	39.2	1.46
Italy	1.20	[6]3.07	[6]48.8	[6]1.81
Japan	1.62 ([3]0.79)	[6]3.44	[6]54.6	[6]2.04
Lebanon	[1]0.50	2.47	39.2	1.46
Mexico†	†	2.11	33.5	1.25
Morocco (Casablanca)	0.89	2.81	44.6	1.66
Netherlands	1.04	2.94	46.7	1.74
New Zealand	1.94 ([3]1.17)	3.72	59.0	2.20
Norway	1.16	3.04	48.3	1.80
Pakistan	[1]0.32	2.31	36.7	1.36
Peru	0.60	[6]2.55	[6]40.5	[6]1.51
Phillipines	1.24 ([3]0.48)	3.11	49.4	1.84
Portugal	0.91	[6]2.82	[6]44.8	[6]1.67
Puerto Rico	0.21	2.21	35.1	1.31
Spain	0.90	[6]2.82	[6]44.8	1.67
Sweden	1.20	3.07	48.8	1.81
Switzerland	1.12+[5]1.00	4.00	63.5	2.36
Turkey	[1]1.20	3.07	48.8	1.81
United Kingdom	1.04	2.94	[9]46.7	1.74
Uruguay	0.99	[6]2.89	[6]45.9	[6]1.71
Venezuela or U. S. Gulf	...	2.03	32.2	1.20
United States	...	[8]1.69	[8]26.8	1.00

*Approximate from Caribbean except as indicated and to a major port. See Table 2 for variation in tanker rates.

†Use Veracruz or Tampico, Mexico, fuel price.

‡Based on USMC—13% plus fuel price at appropriate source. At major ports unless indicated otherwise.

§Includes any refinery gas burned (average 43%) and accordingly, the value of a bbl. of products must be credited with fuel gas and with coke burned from catalyst.

¶Varies widely depending on tanker-transportation rates.

(1) From Persian Gulf, but use Caribbean Bunker C price.
(2) From Los Angeles and use San Pedro (Calif.) fuel price.
(3) From Palembang, Sumatra but use Singapore fuel price.
(4) Mediterranean ports.
(5) Estimated rail freight.
(6) Price may be higher because of import duties or local taxes.
(7) Price is probably fixed by USSR prices.
(8) Average for entire U.S. industry and this includes the value of refinery gas (average of 43%) at its fuel-oil equivalent and about 37% cheap natural gas.
(9) Possibly some cheaper coal available.
(10) Actual refinery price 108 cruzieros which indicates a practical exchange rate of 38.8 cr. per dollar.

TABLE 2—CHANGES IN USMC SPOT TANKER RATES* SINCE 1937 (APPROXIMATE).

	Cents per barrel (residual fuel) U. S. Gulf to N. of Hatteras	Ras Tanura to U.K.	USMC §plus or minus— U. S. Gulf to N. of Hatteras	Ras Tanura to U.K.	Est. avg.‡
1937	42.6	...	− 6	.....	− 3
38	21.6	...	−52	.....	−46
39	25.1	...	−45	.....	−41
40	46.9	...	+ 3	.....	+ 6
1941	56.9	...	+25	.....	+30
42	48.0	...	+ 6	.....	+10
43	48.0	...	+ 6	.....	+10
44	48.0	...	+ 6	.....	+10
45	47.1	...	+ 4	.....	+ 8
46	43.8	...	− 3	.....	0
47	43.8	...	− 3	.....	0
48	58.3	...	+29	.....	+ 7
49	28.0	113	−38	− 35	−32
50	41.1	173	− 9	0	− 1
1951	87.4	348	+93	+101	+95
52	74.7	288	+65	+ 66	+65
53	31.5	...	−30	.....	−35
54	30.6	...	−33	.....	−40
55	43.2	†135	− 5	.....	‡−13
56	76.2	290	+68	§+127	+60
57	74.4	284	+64	§+ 98	+23

*USMC Rate Orders—see OGJ, September 7, 1953, p. 113.

†Estimate.

‡Estimated from all available sources.

§Shipments to United Kingdom are now based on SCALE basic rates.

Fuel prices are published daily in Platt's Oilgram Service and monthly in National Petroleum News. Tanker rates are also published in The Oil and Gas Journal, Petroleum Week, and Oilgram Service.

- Breather outlets
- Scraper-blade change
- Aluminum metalizing
- Turbine packing:

On the Job
IN THE PLANTS

These plant modifications can boost service

BY LARRY RESEN
District Editor

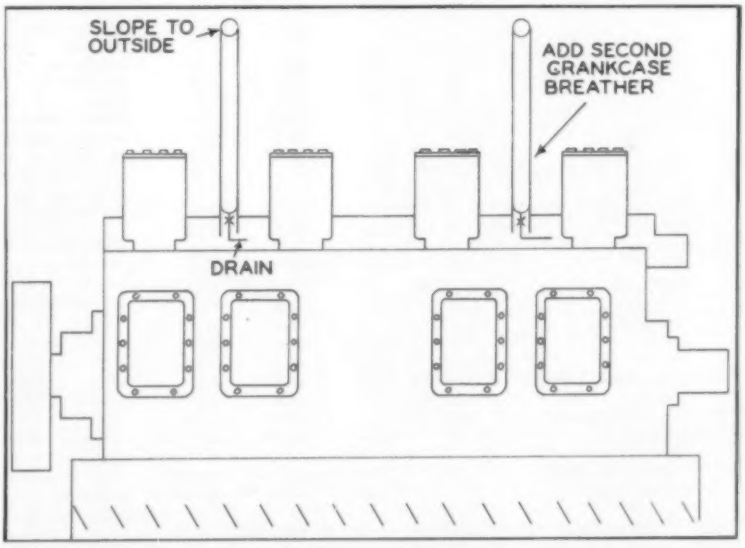
IMPROVED gas engine - compressor service has resulted from several on-the-job modifications made at Arkansas Louisiana Gas Co.'s Columbia gasoline plant near Magnolia, Ark., under the direction of T. O. Hamaker, plant superintendent, and G. E. Freeman, maintenance foreman. An additional on-the-job feature at the plant involved the installation of leakproof packing glands on steam-turbine governors.

In the original gas engine-compressor installation — Ingersoll - Rand XVG's—a single breather pipe was used to evaluate vapors from the engine crankcase. The breather pipe was sized sufficiently to handle all of the vapors which might come off the crankcase. However, the size of the crankcase made it possible for pockets to develop, making it difficult for all of the vapors to have unimpeded access to the breather outlet.

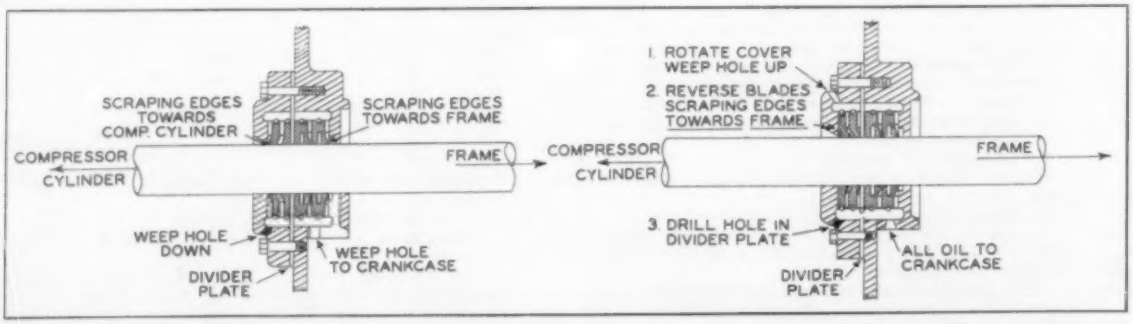
Vapor pockets existing due to the above condition made it possible for the vapors to be cooled within the upper section of the engine. As a result condensation took place which caused contamination of the lubricating oil. Buildup of sludge and discoloration of the oil accelerated by pressure of water vapor. Hence, frequency of the oil changes was increased.

A modification was made and a second breather outlet was installed upon the suggestion of Magnolia Petroleum Co.'s lubricating-oil sales department. The original one was located on one side of the engine between the two rear cylinders. The new one was then located toward the front of the engine between two of the forward cylinders (Fig. 1). By this means, the breather outlet area was fully doubled. More important, however, vapors did not have to travel from the front end of the crankcase to the rear breather pipe to escape. Instead, they have their own readily accessible outlet. Crankcase pressure was reduced as a result of this arrangement.

Both breather outlets have a vertical riser which carries the vapors to an overhead run of pipe which extends outside the compressor building. This is in preference to permitting the breathers to expel vapors within the compressor building,



BREATHER OUTLET added to gas-engine compressor is located toward the front of the engine between two of the forward cylinders. Fig. 1.



SCRAPER-BLADE CHANGE was made by reversing scraper blades on compressor side so blades pointed inward toward the frame (right) instead of towards the compressor piston. Fig. 2.

which creates a housekeeping problem.

It's quite important that the lateral run of the vapor line be slightly pitched to the outside of the building. Otherwise, condensation which occurs here may cause liquids to run back into the engine. The bottom of the vertical riser, in turn, is equipped with a drain line to remove any condensate which occurs in the riser.

The improved breather installation has functioned to hold down the rate of sludge in the lubricating oil. As a result frequency of oil changes has been extended, with a resultant decrease in oil consumption.

Scraper packing . . . The piston rod running from the engine to the compressor cylinder is equipped with scraper-blade packing rings (Fig. 2). These metallic assemblies are housed in a packing gland, with two rings on the frame side and two rings on the compressor side. A divider plate separates the packing into two compartments.

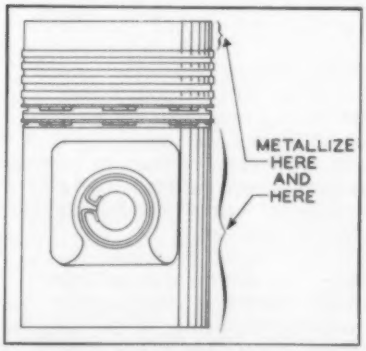
The scraper blades are normally installed so the ones on the frame side point toward the frame while the ones on the compressor side point toward the compressor piston. As the piston rod travels back and forth, oil is scraped toward the frame—and crankcase—on the one side and towards the compressor piston on the other.

Oil removed from the rod passes downward through weep holes in the gland housing. Oil scraped from the rod on the frame side is returned directly to the crankcase, while that removed on the compressor side goes to waste.

A change was made to eliminate the loss of this oil. The scraper blades on the compressor side were reversed so the blades point inward **toward** the frame. A hole was drilled through the divider plate making it possible for oil to pass from one side of the gland to the other.

Finally, the plate on the compressor side of the gland housing was rotated 180° and secured with its weep holes at the top. With this arrangement, any oil removed on the scraper side will collect in the bottom of the gland, pass through the divider-plate opening and then end up in the crankcase along with oil removed from the frame side.

This is practical with the same oil used in the lubricator being satisfactory for crankcase use. Oil makeup requirements have dropped with this setup and housekeeping has been simplified since no oil is discharged to drip.



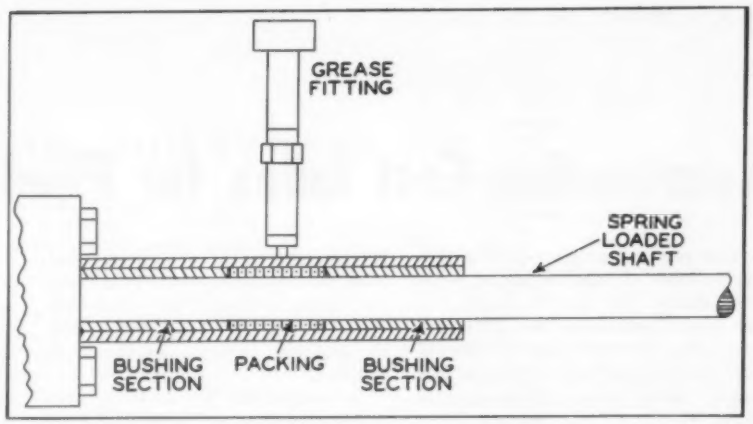
ALUMINUM METALIZING of power cylinders at indicated parts extend piston life. Fig. 3.

Aluminum metalizing . . . Application of aluminum to worn pistons via the use of the metalizing process has proved a practical means of extending piston life (Fig. 3). By this method, melted aluminum is sprayed onto the piston's surface through use of special equipment.

Freeman recommends spraying the aluminum on to a thickness of $\frac{3}{32}$ in. in the raw stage. This surface can then be accurately turned down to obtain a final even coat $\frac{1}{16}$ in. thick. A considerable amount of aluminum is removed by this method, but this insures against any metalizing flaws or holidays.

The aluminum as applied to all piston working surfaces with the exception of the dividers between the ring grooves. These are not coated since it is too difficult to get the metal to bond properly on such narrow surfaces. Oversize rings are used with the pistons and the cylinders on the engine are rebored to a 0.125 in. overbore.

Aluminum applied to power pistons by this method has held up satisfactorily. They have been checked periodically and the last inspection after 2½ years' service found the pistons to still be in good shape. Metalizing was suggested by an Ingersoll-Rand representative. The actual application was done in Arkansas' Taylor compressor station machine shop.



TURBINE PACKINGS make it possible to stop steam leaks without shutdown of turbine or trying to repack without cutting off steam. Fig. 4.

Turbine packing . . . In the governor assembly of a Carling steam turbine, a spring-loaded shaft extends out from the unit housing. In the course of operation, steam leaks naturally occur and it becomes necessary to replace the packing.

Unfortunately, this requires a shutdown of the turbine or a ticklish job of trying to repack without cutting off the steam.

A modification was made which makes it possible to stop any leaks which might occur without the drawbacks noted (Fig. 4). The shaft in question extends through a bushing in the outer housing. A section was cut out of the bushing so that a gap existed around the shaft about midway in the housing.

This gap was filled with asbestos packing. An access hole was drilled and tapped through the housing and into this packing area. A common screw-type grease fitting was then installed on the housing.

The grease fitting is normally filled with a heavy grease reinforced with graphite to achieve a heavy consistency similar to putty. When a leak develops, it is only necessary to screw down on the fittings which then impregnate the packing with this graphite-grease mixture.

In this manner the packing is reinforced through the pressured influx of the incoming grease mixture. The leak is halted and operations can continue until a normal shutdown period when new packing may be installed.

Acknowledgments

Cooperation of T. O. Hamaker, superintendent of Arkansas-Louisiana's Columbia plant and G. E. Freeman is gratefully acknowledged.

By W. L. NELSON, Technical Editor

Questions on TECHNOLOGY

Construction Cost Index for Pipelines

Can you give us more information on the costs of constructing oil pipelines during the last 10 years? We see your Costimating No. 22 in the December 3, 1956, issue of The Oil and Gas Journal, but we thought you might have more information.—R. W. T.

Last October the valuation figures of the Interstate Commerce Commission were published in the hearings before the Antitrust Subcommittee on the Judiciary (October 21-24, 1957). In the two volumes (Part 1) entitled "Consent Decree Program of the Department of Justice," are shown detailed costs for all of the costs involved in pipeline construction for the year 1934 and for many of the years up to 1957. The costs are assembled into yearly totals so that an index of the construction cost of pipelines can be stated (see Table 1). These indexes have been converted to the 1946 basis used in The Oil and Gas Journal, as shown in Table 1.

TABLE 1
Construction Cost Indexes for Oil Pipelines (1946 = 100)

(Interstate Commerce Commission, Bureau of Evaluation)

	Gathering lines*	Trunk lines*	All oil lines
1935	....	....	69.5
1936	....	....	69.5
1937	....	....	71.5
1938	....	....	70.2
1939	....	....	65.6
1940	....	....	66.2
1941	....	....	76.2
1942	....	....	88.1
1943	....	....	94.0
1944	....	....	91.4
1945	....	....	92.6
1946	***100.0**	***100.0**	**100.0**
1947	*114.5	*114.5	114.5
1948	134.0	134.0	134.0
1949	141.0	141.0	141.0
1950	146.7	146.7	146.7
1951	154.6	154.6	154.6
1952	160.3	160.3	160.3
1953	167.2	168.3	168.3
1954	166.0	167.2	167.2
1955	169.4	170.8	170.8
1956	183.3	185.7	185.7

*Cost increase between 1946 and 1947 assumed to be the same as for "All oil lines" column.

In Costimating No. 22 (December 3, 1956) a pipeline index consisting of 50 per cent finished steel, 5 per cent engines, and 45 per cent labor, was suggested. This does not check very well with the ICC index, but the reason for the discrepancy is evident. The cost of installing pipelines has not increased as rapidly as have wages.

This means that the productivity of labor, assisted by technological improvements in the technique of laying pipeline, has increased greatly since 1935. A precise evaluation of the increase in production is not possible, but shown in Table 2 is an approximation based on labor rates (half skilled and half common labor), and the installation costs (pipe and fittings, coatings, casing and vents, pipe or cable bridges, etc.) shown by the ICC valuation.

TABLE 2
Approximation of the Productivity of Labor (or the Advancement in Installation Techniques) in the Construction of Oil Pipelines (1946 = 100)

	Installation cost (ICC)*	Wages†	Productivity
1935	58	55	105.5
1936	60	60	100.0
1937	60	66.5	91.8
1938	60	71.5	84.0
1939	55	73	75.5
1940	55	74.5	73.9
1941	66	77	85.6
1942	87.5	82	106.8
1943	107	86.5	123.7
1944	97	88.5	109.6
1945	96	90	106.8
1946	**100.0**	**100.0**	**100.0**
1947	106.5	113.5	106.5
1948	116	128	110.3
1949	121	137.1	113.2
1950	127	144	113.3
1951	132	152.5	115.7
1952	138	163.1	118.1
1953	144	174.2	121.0
1954	130	183.3	141.0
1955	129	189.6	147.0
1956	145	198.2	136.7
1957	...	108.6	....

*Codes 105 and 155 of Bureau of Valuation of ICC. †Half skilled and half common labor (Eng. News Record).

Labor is also included in other items but in such a way that isolation of its effect cannot easily be determined. Table 2 indicates clearly that the total cost of construction (as well as that of installation) has not risen as fast as one might expect because of mechanization and superior supervision in the laying of pipelines, which together have increased the output or productivity of labor.

An enormous amount of detailed cost information is contained in the two volumes.

Thermal Stability of Fuels

Why is a thermal stability test of jet fuels necessary? G. S.

Jet planes now operate at such high speeds that the surface of the plane (i.e., air coolers, etc.) attains a high temperature. Thus, the fuel tanks, and in fact the whole equipment, tend to become heated. In addition, in some modifications the fuel has been circulated past parts of the engine that are lubricated and this tends to increase the fuel temperature.

During the present stage of development, the use of heat stable fuels appears to be useful. Thus, the specifications of JP-6 military jet fuels (MIL-F-25656, USAF, September 10, 1956) calls for a fuel that can be heated to 400° F. and filtered at 500° F. in a continuous test for a period of 5 hours without causing a pressure drop of more than 10 in. of mercury across the filter, nor a deposit on the heater tube that is darker than light tan.

If speeds should be further increased, it is obvious that we will eventually encounter temperatures that require refrigeration, or the use of mineral rather than hydrocarbon fuels.

PIPELINE

CONSTRUCTION REPORT

Who's Laying Line—and Where

PIPELINE activity reported here is compiled from surveys conducted by The Oil and Gas Journal among pipeline companies and contracting firms. Projects listed include those proposed, contracted, and under way.

U.S. Crude-Oil Pipelines

- **Belle Fourche Pipeline Co.**
  Project: 30 miles of 6-in. from Donkey Creek pool to Fiddler Creek pool in northeastern Wyo. Will later build a line from Fiddler Creek to connect with Butte Pipe Line Co. near Osage, Wyo.
  Status: Planned.
- **Cape Pipe Line Co.** (Sun Oil Co., Cities Service Co., Atlantic Refining Co.)
  Project: Line from lower Delaware Bay to Philadelphia.
  Status: Planned.
  Completion: 1960.
- **Cooperative Refinery Association**
  Project: 6 miles of 6-in. in Washington County, Oklahoma.
  Completion: Mid-June 1958.
- **El Paso Natural Gas Products Co.**
  Project: Verde Gallup-Horseshoe Canyon gathering system, San Juan County, New Mexico; 42 miles of 2, 3, 4, 6, 8-in.
  Status: Under way.
  Contractor: **Northwest Construction, Inc.**, Farmington, N. M.
  Completion: April 1, 1958.
- **Gillette Pipeline, Inc.** and **A. W. Hartwig, Inc.**
  Project: A 102-mile line from Dead Horse Creek field to Casper. Wyo.
  Status: Has applied for permit from Wyoming Public Service Commission.
- **Great Northern Railway Co.**
  Project: 400 to 600 miles of 12 to 20-in. from Williston basin in Montana and North Dakota, to Clearbrook or St. Paul, Minn.
  Status: Planned.
  Contractor: **Pipe Line Technologists, Inc.** has completed feasibility study.
- **Humble Pipe Line Co.**
  Project: 90 miles of 16-in. from Hawley to Comyn, Tex.
  Status: Under way.
  Contractor: **O. R. Burden Construction Corp.**, R. M. Jones, supt., office at Cisco, Tex.
  Completion: Summer 1958.
- **Jayhawk Pipeline Corp.** (Colorado Oil & Gas Corp., National Cooperative Refinery Association)
  Project: 242 miles of 10 and 12-in. from western Meade County, Kansas, to Valley Center near Wichita.
  Status: Will start spring 1958.
  Contractor: **Pipe Line Technologists**, Houston, has engineering contract.
  Completion: August 1958.
- **Magnolia Pipe Line Co.**
  Project: 40 miles of 16-in. from Hull Station to Beaumont, Tex., to replace several smaller older lines.
  Status: Under way.
  Contractor: **Panama Construction Co.**
  Completion: June 1, 1958.
- **Offshore Gathering Corp.**, Houston.
  Project: 364 miles of mostly 20-in. in Gulf of Mexico off Louisiana. (Dual line.)
  Status: Proposed.
- **Oil Field Pipe Line, Inc.**
  Project: 200 miles 8 and 12-in. from near Elkhart, to Ellinwood, Kans.
  Status: Proposed.
- **Portland Pipe Line Corp.** and **Montreal Pipe Line Co., Ltd.**
  Project: 39 miles of 24-in. loops in U. S. and 11 miles in Canada along its 242-mile dual 12 and 18-in. system between Portland, Me., and Montreal, Que.
  Status: To start spring 1958.
- **Service Pipe Line Co.**
  Project: 75 miles of 20-in. between Casper and Laramie, Wyo.
  Status: Planned.
  Completion: Summer or fall 1958.
- **Shell Oil Co.**
  Project: 20 miles of 6-in. from Vallecitos field in eastern San Benito County to main Bakersfield-to-Martinez line in Fresno County, California.
  Status: Planned.
  Completion: Late July 1958.
- **Shell Pipe Line Corp.**
  Project: 11 miles of 8-in., 3 miles of 10-in., 10 miles of 12-in., 37 miles of 16-in., and 60 miles of 20-in. from Mississippi River Delta area to New Orleans refining area.
  Status: Planned.
  Contractor: **Coates Field Service, Inc.**, has right-of-way acquisition and claims settlement.
  Completion: September 1958.
- **Sinclair Pipeline Co.**
  Project: 150 miles of 20-in. from Teague, Tex., to Houston.
  Status: Under way.
  Contractor: **Lone Star Constructors, Inc.** has 143 miles; **Golightly Construction Corp.** has 6 miles.
  Completion: July 1, 1958.
- **Southern Kansas Pipeline, Inc.**
  Project: 200 miles of 6 to 10-in. in Kans. from southwestern Meade County to 10 miles north of Arkansas City.
  Status: Proposed. Request filed with Kansas Corporation Commission for permit.
- **Texas-New Mexico Pipe Line Co.** (Sinclair, Texas Co., Tidewater, Empire)
  Project: 512 miles of 16-in. from southeast corner of Utah to Jal, N. M.
  Status: Under way.
  Contractor: **Four Way Co., Inc.**, has 150 miles from Aneth field southeast. **Panama, Inc.**, has completed 362 miles from Cuba to Jal.
  Completion: May 1958.
- **Toronto Pipe Line Co.**
  Project: 18 miles of 4-in. from Nebraska fields to Redington, Nebr.
  Status: Under way.
  Contractor: **H & B Construction Co.**, Sterling, Colo.
  Completion: April 1, 1958.

U.S. Products Pipelines

- **Alaska-Yukon Refiners & Distributors, Ltd.**
  Project: Two lines: one 150 miles from Haines to Haines Junction, Alaska, linking with government Canol line; another from Tok Junction, on Canol line, to Anchorage.
  Status: Proposed.
  Completion: 1959.
- **American Pipe Line Co.**
  Project: Line from Gulf Coast to New York City. Has ODM approval to amortize 40 per cent of cost with fast writeoff.
  Status: Proposed.
- **Buckeye Pipe Line Co.**
  Project: 70 miles of 8-in. from Wayne to vicinity of Durand, Mich.
  Status: Planned.
  Completion: 1958.
- **Cherokee Pipe Line Co.** (Continental Oil Co., Cities Service Oil Co.)
  Project: 78 miles of 12-in. from Ponca City to Tulsa, Okla.
  Status: Under way.
  Project: Conversion of 400 miles of 10-in. crude line between Glenpool, Okla., and Wood River, Ill.
  Status: Planned.
- **Columbia Gas System, Inc.**
  Project: Line from proposed plant near Kenova, W. Va., to proposed plant and storage facilities at Siloam, Ky.
  Status: Planned.
  Status: Proposed.
- **Everglades Pipe Line Co.**
  Project: 60 miles of 10-in. from Port Everglades, Fla., to Miami's International Airport and terminals south.
  Status: Under way.
- **Interstate Oil Pipe Line Co.**
  Project: 16 miles of 4-in. LPG line from Baton Rouge to Plaquemine, La.
  Status: Under way.
  Contractor: **J. C. Campbell Construction Co.**
  Completion: June 1, 1958.
- **Katy and New York Central Railroads**
  Project: 2,000 miles of 10 or 12-in. from Houston through Kansas City, St. Louis, Indianapolis and Cleveland to Syracuse then down to New York City. A branch would go through Chicago to Detroit.
  Status: Planned.
  Contractor: **Williams Brothers Co.** has feasibility study.
  Completion: November 1, 1959.
- **Laurel Pipe Line Co.** (Gulf Refining Co., Sinclair Pipe Line Co., The Texas Co.)
  Project: 100 miles of 24-in. and 340 miles of line graduating down to 14-in. at the west terminus, from Philadelphia to Cleveland.
  Status: To start April 1958.
  Contractor: **Pipe Line Maintenance & Construction Co.**, Camp Hill, Pa., has Susquehanna River crossing. **Missouri Valley Dredging Co.**, Omaha, Neb., has 6 miles of 24-in. from Eagle Point, N. J., to west bank of Delaware River, including Delaware River crossing, and 20 miles of 24-in. from west bank of Delaware River to Laurel's Booth station site in Delaware County, Pennsylvania. **Engineers Limited Pipe Line Co.**, San Francisco, has 106 miles of 24-in. from Booth station to Mechanicsburg station near Harrisburg, Pa. **Panama, Inc.**, Houston, has 78 miles of 20-in. from Mechanicsburg station to Duncansville station, and 113 miles of 18-in. from there to Aliquippa station in Beaver County, Pennsylvania, including Allegheny and Ohio rivers crossing. **Williams Brothers Co.**, Tulsa, has 106 miles of 14-in. from Aliquippa station to Cleveland.
  Completion: August 1958.
- **Leonard Refineries, Inc.**
  Project: 43 miles of 6-in. from Alma to Lansing, Mich.
  Status: Planned.
  Contractor: **Welded Construction Co.**
  Completion: Spring 1958.
- **Ohio Oil Co.**
  Project: 265 miles of 12-in. from Wood River, Ill., to Chicago.
  Status: To start July 1958.
  Completion: 1958.
- **Underground Storage & Exploration, Inc.**
  Project: 393 miles of 12-in. L.P.G. line

from Moundsville, W. Va., to Newark, N. J., plus 95 miles of 6, 8-in. laterals to Mauch Chunk, Pa., and to Philadelphia.
Status: Proposed.

• **Union Oil Co. of California**
Project: 815-mile line from Rifle, Colo., to Los Angeles refining area.
Status: Proposed.

U.S. Natural-Gas Pipelines

• **American Louisiana Pipe Line Co.**
Project: 7 miles of 16-in. and 5 miles of 12-in. from Second Bayou to Cameron, La.
Status: Under way.
Contractor: **Ford, Bacon & Davis Construction Corp.**
Completion: December 1958.

• **Arkansas Louisiana Gas Co.**
Project: A 300-mile line, plus gathering lines, from Tex.-La. coastal area to northern La., to connect with present system.
Status: Long-range plans.

• **Carnegie Natural Gas Co.**
Project: Two parallel lines to provide coke-oven gas to six Pittsburgh area plants: 9 miles of 55-in. and 4 miles of 43-in. each
Status: Under way.
Contractor: **Williams Brothers Co.**
Completion: January 1, 1959.

• **Chicago District Pipeline Co.**
Project: 52 miles of 30, 36-in. between Joliet and Chicago, Ill.
Status: Approved by FPC examiners.
Completion: 1958.

• **Cities Service Gas Co.**
Project: 6 miles of 30-in. in Montgomery County, Kansas, and 18 miles of 26-in. in Anderson and Franklin counties, Kansas.
Contractor: **R. H. Fulton & Co.** has the 26-in.

• **Coastal States Gas Producing Co.**
Project: A 20-mile gathering system from the Rock Island area of Colorado County, Tex., to the United Gas Corp. system.

• **Coastal States Gas Producing Co.** and **Southern Coast Corp.**
Project: 45 miles of 2 to 10-in. in Bee County, Tex. to connect presently shutin fields with Texas Eastern Transmission Corp.'s system.
Status: Planned.

• **Coastal Transmission Corp.**
Project: 94 miles of 12-in. between Monte Christo, Tex., and Robstown, Tex.; 175 miles of 20-in. between Robstown and Lochridge, Tex.; 102 miles of 22-in. between Lochridge and Beaumont, Tex.; 193 miles of 24-in. between Beaumont and Baton Rouge, La.
Status: Approved. Survey and right-of-way work under way.
Completion: February 1, 1959.
Project: 365 miles of 3 to 14-in. gathering lines at various locations on Texas and Louisiana Gulf Coast.
Status: Approved.
Completion: February 1, 1959.

• **Colorado Interstate Gas Co.**
Project: 66 miles of 30-in., 40 miles of 34-in., 109 miles of 26-in., and 100 miles of 24-in. from Springfield, Colo., to Pubelo, Colo.; 345 miles of 30-in. from Kit Carson, Colo., to Beatrice, Neb.; 24 miles of 22-in. Tex. Panhandle looping.
Status: Approved by FPC examiners. Delayed until 1959.

• **Commonwealth Natural Gas Corp.**
Project: 6 miles of 12-in. from Waverly to southeast of Wakefield, Va.
Status: Planned.
Completion: July 1, 1958.
Project: 13 miles of 18-in. from Chester to Petersburg compressor station in Va.
Status: Planned.
Completion: September 1, 1958.

• **Consolidated Gas Utilities Corp.**
Project: 21 miles of 12-in. and 10 miles of 8-in. at Altus, Okla.
Status: Approved.

• **Consumers Power Co.**
Project: 45 miles of 24-in. from Overisel field to Lansing Gas system in Mich.
Status: Planned.
Completion: September 1, 1958.

• **Eastern Shore Natural Gas Co.**
Project: 34 miles of 8-in. and 90 miles of 6-in. from connection with Transcontinental Gas Pipe Line Corp., in Maryland, across entire length of Delaware to Salisbury.
Status: Approved.

• **El Paso Natural Gas Co.**
Project: 18 miles of 12-in. between Good Field in Borden Co., and the East Vealmoor gasoline plant in Howard Co., Tex.
Status: Has temporary FPC approval.
Project: 177 miles of 20-in. from Sonora plant, Sutton County, to Plains plant, Yoakum County, Texas.
Status: Planned. Filed for FPC permit.
Completion: July 1, 1958.
Project: 193 miles of 30-in. Permian-San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: September 1, 1958.
Project: 216 miles of 6 to 34-in. and 533 miles of various size in Ariz., Tex., N. M.
Status: Filed for FPC permit.
Project: 38 miles of various size line to make additional gas available at the McElroy-Wilshire plant near Crane, Tex.
Project: 500 miles of 34-in. from Twin Falls, Idaho to California border near Las Vegas, Nev.
Status: Planned.
Completion: September 1, 1959.
Project: 59 miles of 20-in. in Crane County, Texas, and 9 miles of various size field lines in Pecos County, Texas.
Status: Filed for FPC approval, February 5, 1958.

• **Equitable Gas Co.**
Project: 12 miles of storage line in Lewis Co., W. Va.
Status: Approved.

• **Gulf Interstate Gas Co.**
Project: 10 miles of 12-in. supply loop to Erath field, Vermilion Parish, Louisiana, and 9 miles of various size field lines in Acadia and Vermilion parishes, Louisiana.
Status: Approved.
Project: 10 miles of 20-in. loop in Jefferson Davis and Vermilion parishes, Louisiana, and 3 miles of 6-in. loop in Cameron Parish, Louisiana.
Status: Has temporary FPC approval.
Project: 352 miles of 30-in. loop between Louisiana and Leach, Ky.; 54 miles of 24-in. lateral in Louisiana.
Status: Has temporary approval.
Completion: 1959.

• **Houston Texas Gas & Oil Corp.**
Project: 702 miles of 24-in. from Baton Rouge, La., to Kissimmee, Fla.; 139 miles of 18-in. and 101 miles of 20-in. from Kissimmee to Cutler, Fla.; 642 miles of 3 to 18-in. sales laterals in Florida. Main line to join Coastal Transmission's line from McAllen, Tex., to Baton Rouge.
Status: Under way.
Contractor: **Midwestern Constructors** has the 702 miles of 24-in.; **Harbert Construction Corp.** has remainder.
Completion: June 1958.

• **Humble Oil & Refining Co.**
Project: 250 miles of 26 or 30-in. from Southwest Texas area to Houston, plus 200 miles of various size gathering lines.
Status: Planned.

• **Iron Ranges Natural Gas Co.**
Project: 70 miles of 6 to 16-in. in Mesabi Iron Range area.
Status: Pending FPC approval.
Completion: November 1, 1958.
Project: 63 miles of 12-in. between Duluth and Silver Bay, Minn.
Status: Pending FPC approval.
Completion: November 1, 1958.

• **Kerr-McGee Oil Industries, Inc.**
Project: 24 miles of 4-in. in Blocks 21, 22, and 32 to connect wells with its Breton Sound production island off the Louisiana coast.

• **Kentucky Gas Transmission Corp.**
Project: 21 miles of 26-in. to parallel its 20, 24-in. lines from its Foster regulating station in Bracken County, Kentucky, to Campbell, Ky.
Status: Filed for FPC approval February 13, 1958.

• **Lone Star Gas Co.**
Project: 31 miles of 16-in. loop in Freestone and Limestone counties, Texas.
Status: Under way.
Contractor: Company forces.
Completion: April 1, 1958.
Project: 18 miles of 6-in. loop in Hamilton County, Texas.
Status: Planned.
Contractor: Company forces.
Completion: July 1, 1958.
Project: 11 miles of 16-in. relocation of line around Abilene, Tex.
Status: Planned.
Contractor: Company forces.
Completion: August 1, 1958.
Project: 12 miles of 12-in. replacement of line in Haskell County, Texas.
Status: Planned.
Contractor: Company forces.
Completion: June 1, 1958.
Project: 22 miles of 20-in. loop in Henderson and Navarro counties, Texas.
Status: Planned.
Contractor: Company forces.
Completion: October 1, 1958.

• **Manufacturers Light & Heat Co.**
Project: 3 miles of 12-in. from Wellsville to a point in Saline Township, Ohio; 8 miles of 12-in. in Brook County, W. Va.; 4 miles of 10-in. in Ohio County, W. Va.
Status: Approved.

• **Michigan Consolidated Gas Co.**
Project: 67 miles of 10 and 12-in. between Sears and Travers City, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.**; Floyd Huduall, supt., office at Cadillac.
Project: 60 miles of 10 and 12-in. between Muskegon and Ludington, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.**, jointly with **H. L. Gentry Construction**, Frank Morris, superintendent, office at Hart, Mich.
Project: 40 miles of 26-in. from storage fields in Michigan, to Consumers Power Co. distribution system.
Status: Pending FPC approval.

• **Michigan Wisconsin Pipe Line Co.**
Project: 33 miles of 4, 6-in., 2 miles of 12-in., 4 miles of 10-in., and 7 miles of 8-in. gathering lines in LaVerne Field, Harper County, Okla.
Status: Planned. Pending FPC approval.
Completion: October 1, 1958.
Project: 56 miles of 20-in. extension of LaVerne line, Harper County, Okla.
Status: Planned. Pending FPC approval.
Completion: October 1, 1958.
Project: 25 miles of 12-in. and 21 miles of 24-in. loops in Wis. and Mich.
Status: Planned. Pending FPC approval.
Completion: October 1, 1958.

• **Midwestern Gas Transmission Co.**
Project: Line from Portland, Tenn., to Minnesota-Canada border near Emerson, Man.: 670 miles of 30-in., 218 miles of 20-in, 371 miles of 16-in., 115 miles of

PIPELINE CONSTRUCTION

12-in., 70 miles of 10-in., 179 miles of 8-in., 147 miles of 6-in., 174 miles of 4-in., 106 miles of 3-in.

Status: Pending FPC approval.

• **Mookl Chemical & Gas Corp. and Missouri Transmission Corp.**

Project: 425 miles of 16-in. from Pottawatomie County, Okla., to St. Louis. Mookl, 1341 S. Boston, Tulsa, will build Okla. section. Missouri Transmission, Springfield, Mo., will build the Mo. section.

Status: Initial FPC filing rejected. Will refile.

• **Natural Gas Pipeline Co. of America**

Project: 389 miles of 36-in. loops along its line from Beatrice, Neb., to Chicago, to take gas from proposed line of Colorado Interstate Gas Co., and 91 miles of 30-in. loops along parts of its main line.

Status: Approved by FP Cexaminer. Delayed until 1959.

Project: 337 miles of 30-in. between Fritch, Tex., and Beatrice, Neb., and 59 miles of 36-in. between Beatrice and Joilet, Ill., along existing system.

Status: Pending FPC approval.

Completion: 1959.

• **New York State Natural Gas Corp.**

Project: Will replace 12 miles of 20-in. with 30-in. and 13 miles of 12-in. with 20-in. in Pa.

Status: Planned.

• **North Carolina Natural Gas Corp.**

Project: 630 miles of 2 to 16-in. from near Mooresville, eastwardly across N. C.

Status: Under way.

Completion: Spring 1958.

• **Northern Illinois Gas Co.**

Project: 140-mile line from Dubuque, Iowa, to Des Plaines, Ill.

Status: Pending FPC approval.

Completion: Fall 1958.

• **Northern Natural Gas Co.**

Project: 23 miles of 24-in. loops in Nebr. and Iowa; 43 miles of 30-in. loops in Kans., Nebr., and Iowa; 169 miles of 20-in. from Farmington, Minn., to Superior, Wis.; 44 miles of 16-in. in Duluth-Superior-Iron Ranges area.

Status: Pending FPC approval.

Project: 73 miles of 20-in. from Savanna Creek to Pincher Creek fields in Alberta, Canada; 32 miles of 24-in. from Pincher Creek to Montana border; 1,100 miles of 26-in. from Montana into Minneapolis.

Status: Proposed.

Project: 1,090 miles of 2 to 16-in. branch lines to serve communities in Minn., Iowa, S. D., Nebr., Wis.

Status: Filed with FPC March 18, 1957.

• **Northern Utilities Co.**

Project: 35 miles of 16-in. in Fremont-Natrona County, Wyoming, area; 8 miles of 12-in. around Casper; 6 miles of 8-in. from Sand Draw gas field to Beaver Creek field; 12 miles of 6-in. from Beaver Creek field to the system servicing the Riverton-Lander area.

Status: Planned.

• **Offshore Gathering Corp.**

Project: 364 miles in Gulf of Mexico off Louisiana: 60 miles of 24-in., 70 miles of 26-in., 234 miles of 30-in. (Dual line.)

Status: Application pending with FPC.

• **Olin Gas Transmission Corp.**

Project: Mississippi River 3 and 8-in. crossing near White Castle, La.

Status: Under way.

Contractor: **Houston Contracting Co.**, A. J. Slovack and R. E. Thornton, supts., office at White Castle.

• **Pacific Gas & Electric Co.**

Project: 5 miles of 16-in., 160 miles of 12-in., 8 miles of 8-in. from Corning to Eureka, Calif.

Status: Under way.

Contractor: **Engineers Limited Pipeline Co.** and **Alex Robertson Co.**

Completion: **June 1958.**

• **Pacific Lighting Gas Supply Co.**

Project: 83 miles of 34-in. from North Coles Levee to Newhall, Calif.

Status: Under way.

Contractor: **Engineers Limited Pipeline Co.**

Completion: **July 1, 1958.**

Project: 128 miles of 34-in. from Topock to Newberry, Calif.

Status: Plans to file for FPC permit.

Completion: November 1, 1959.

• **Pacific Northwest Pipeline Corp.**

Project: 40-mile line from Ute Trail gas fields in northeastern Utah to its main line in western Colorado.

Status: Planned to start spring 1958.

Project: 51 miles of 30-in. from main line to Big Piney field, Wyoming, looping present 16-in. lateral.

Status: Pending FPC approval.

• **Panhandle Eastern Pipe Line Co.**

Project: 95 miles of 4-in., 45 miles of 6-in., 38 miles of 8-in., 3 miles of 10-in., and 12 miles of 12-in. gathering lines in Kansas, Oklahoma, and Texas.

Status: Under way.

Contractor: **Hall Construction Co.**

Completion: December 31, 1958.

Project: 33 miles of 16-in. from Munice, Ind., to Hollansburg, Ohio.

Status: Planned.

Completion: September 1, 1958.

• **Pennsylvania Gas Co.**

Project: 23 miles of 10-in. in Erie County, Pa., 15 miles of 8-in. in Warren and Chautauqua counties, Pa., 30 miles of branch lines, several small distribution lines.

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PIPELINE CONSTRUCTION

Status: Has FPC permit.

• **Permian Basin Pipeline Co.**

Project: 29 miles of 10-in. gathering lines from Crane and Pecos counties to McCamey, Tex.

Status: Under way.

Contractor: **Lone Star Constructors, Inc.**

• **Piedmont Gas Co.**

Project: 78 miles of 2 to 8-in. extension off Trancontinental in North Carolina to serve Gaston, Lincoln, Catawba, Caldwell and Burke counties.

Status: Has FPC approval.

• **Pioneer Gathering System, Inc.**

Project: Gathering lines at Texas fields: 7 miles of 4-in. in Buckhorn field; 2 miles of 6-in., 1 mile of 4-in., and 2 miles of 8-in. in Vinegarone field; 2 miles of 3-in. in Mt. Ketchum field; 4 miles of 3-in., 1 mile of 2-in., and 16 miles of 4-in. in Tilleny field; 7 miles of 2-in. in Mertyon field.

Status: Plans to file for FPC permit.

Completion: November 1, 1958.

Project: 11 miles of 4-in. in Hale and Lamb counties, Texas, and 9 miles of 4-in. in Gaines County, Texas.

Status: Planned.

Completion: Mid-April 1958.

• **Seaboard Oil Co.**

Project: 6 miles of 10-in. in Vermilion and Lafayette parishes.

Status: Has FPC examiner's approval.

• **Shell Oil Co.**

Project: 9 miles of 6-in. from Lake Pontchartrain to Norco, La.

Status: Planned.

• **Signal Oil & Gas Co.**

Project: Considering expansion of gathering system for its sulfur-extraction plant at Tioga, N. D., into the developing oil area near the Canadian border in Burke County.

Status: Decision expected spring 1958.

• **Southern Natural Gas Co.**

Project: Supply lines in South Louisiana: 4 miles of 16-in. Bayou Long field lateral; 7 miles of 16-in. Little Bayou Pigeon lateral; 4 miles of 6-in. Mystic Bayou field lateral; 2 miles of 6-in. East Bayou Pigeon lateral.

Status: Planned. Pending FPC approval.

Project: 7 miles of 24-in. from Gwinville to Pickens, Miss.

Status: Planned. Pending FPC approval.

Project: 13 miles of 10-in. Tanting field lateral in South Louisiana.

Status: Planned. Pending FPC approval.

Project: 3 miles of 8-in. Dexter field lateral in Mississippi.

Status: Planned. Pending FPC approval.

Project: Supply lines in South Louisiana: 46 miles of 20-in. from White Castle to South Section 28 field; 7 miles of 10-in. Bayou Boullion field lateral; 11 miles of 8-in. East Happytown field lateral; 8 miles of 10-in. and 11 miles of 8-in. Loisel field lateral; 17 miles of 20-in. Lake Washington field lateral; 22 miles of 12-in. West Delta Block 30 lateral; 4 miles of 8-in. Bayou Long field lateral; 6 miles of 4-in. Bayou Villars field lateral; 12 miles of 6-in. Marrero field lateral; 6 miles of 6-in. South Lake Long field lateral; 1 mile of 4-in. Tigers Ridge field lateral; 35 miles of 16-in. Montegut field lateral; 13 miles of 16-in. Barataria Line loop; 69 miles of 24-in. from Toca to Franklinton.

Status: Planned. Pending FPC approval.

Project: 45 miles of 4 to 12-in. Black Bay fields gathering system, Plaquemines Parish, Louisiana.

Status: Under way.

Contractor: **Houston Contracting Co.**

Completion: May 1, 1958.

Project: 67 miles of 24-in. from Gwinville to Enterprise, Miss.; 71 miles of 24-in. from Enterprise to Gallion, Ala.; 83 miles of 24-in. from Gallion to Elmore, Ala.; 43 miles of 20-in. and 46 miles of 24-in. from Elmore to Ellerslie, Ga.; 69 miles of 20-in. from Ellerslie to Ocmulgee, Ga.; 79 miles of 16-in. from Ocmulgee to Wrans, Ga.; 8 miles of 6-in. Vicksburg, Miss., loop line; 5 miles of 12-in. Amory, Miss., loop line; 9 miles of 8-in. Calera, Ark., loop line; 23 miles of 14-in. Rome, Ga., loop line; 9 miles of 8-in. at LaGrange, Ga.; 62 miles of 14-in. from Ocmulgee, Ga. to Atlanta, Ga.

Status: Planned. Pending FPC approval.

Project: Facilities to attach additional gas supplies in South Louisiana: 6 miles of 8-in. from Ship Shoals Block 28 to Block 32; 29 miles of 16-in. from Ship Shoals Block 28 to Atchafalaya Bay; 15 miles of 16-in. from north shore Atchafalaya Bay to Patterson; 6 miles of 16-in. from Patterson to Duck Lake; 8 miles of 6-in. Bayou Felice lateral; 1 mile of 4-in. Triumph field lateral; 2 miles of 8-in. Coffee Bay field lateral.

Status: Planned for 1958-1959.

Project: Facilities to attach additional gas supplies in Mississippi: 8 miles of 8-in. Hub field lateral; 40 miles of 14-in. and 40 miles of 16-in. from Cranfield to Gwinville.

Status: Planned for 1958-1959.

Project: Gathering system loops in Louisiana: 42 miles of 20-in. from White Castle to Franklinton; 17 miles of 20-in. from Olga to Toca.

Status: Planned for 1958-1959.

• **Tennessee Gas Transmission Co.**

Project: 556 miles of 30-in. from Mississippi Delta area south of New Orleans to Portland, Tenn.

Status: Has temporary FPC approval.

Project: 76 miles of 24-in. from Coudersport, Pa., to Hamburg, N. Y.

Status: Has temporary FPC approval.

Project: 163 miles of 30-in. and 101 miles of 26-in. from Portland, Tenn., to near Lancaster, Ky.; from Winchester, Ky., to Morehead, Ky.; from Catlettsburg, Ky., toward Broad Run, W. Va.; from New Wilmington, Pa., to Mercer, Pa.; and from Morehead, Ky., to Catlettsburg, Ky.

Status: Has Temporary FPC approval.

• **Texas Eastern Transmission Corp.**

Project: 17 miles of 8-in. and 3 miles of 6-in. from its 20-in. Baytown-Hankamer line to Alco-Mag field in Harris County, Texas.

Status: Has FPC approval.

Project: 140 miles of 30-in. between Kosciusko, Miss., and Uniontown, Pa., 105 miles of 30-in. between Opelousas, La., and Kosciusko, 22 miles of 14-in. supply line in La.

Status: Pending FPC approval.

• **Texas Illinois Natural Gas Pipeline Co.**

Project: 860 miles of 30-in. looping of present system.

Status: Planned.

Completion: 1960-1961.

• **Transcontinental Gas Pipe Line Corp.**

Project: 202 miles of 36-in. and 132 miles of 30-in. main line loop; 150 miles of 23-in. and 24 miles of 24-in. from Leidy storage field in Pa., to its trunk line to N.Y., 202 miles of 10 to 20-in. gathering lines in southeast La.; 48 miles of 10 to 20-in. to tap gas off Tex.

Status: Pending FPC approval.

Contractor: **Bechtel Corp.** has the 150 miles of 23-in. to connect storage in Pa.

Project: 57 miles of 36-in. main line loop.

Status: Pending FPC approval. Planned for 1959.

Project: 87 miles of 24-in. laterals, plus small gathering lines connecting seven Louisiana fields with the New Orleans area.

Status: Pending FPC approval.

• **Transwestern Pipe Line Co.** (Warren Petroleum, Monterey Oil Co.; J. R. Butler).

Project: A line from W. Tex. area to Calif. border.

Status: Proposed.

• **United Gas Pipe Line Co.**

Project: 18 miles of 12-in. from Lirette-Mobile line in Jackson County, south to Bayou Casottee industrial area east of Pascagoula, Miss.

Status: Approved.

Contractor: **Houston Contracting Co.**, L. A. Young, supt., office at Moss Point, Miss.

Project: 202 miles of 30-in. loop from southeast Louisiana, to Mobile, Ala.

Status: Approved.

Project: 12 miles of 16-in. and 16 miles of 8-in. on Gulf Coast of Louisiana, in Terrebone Parish.

Status: Under way.

Contractor: **Brown & Root, Inc.**

• **Western Slope Gas Co.**

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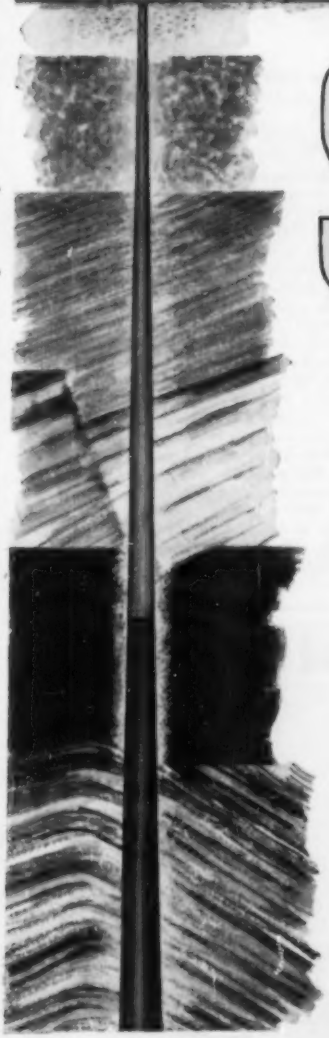

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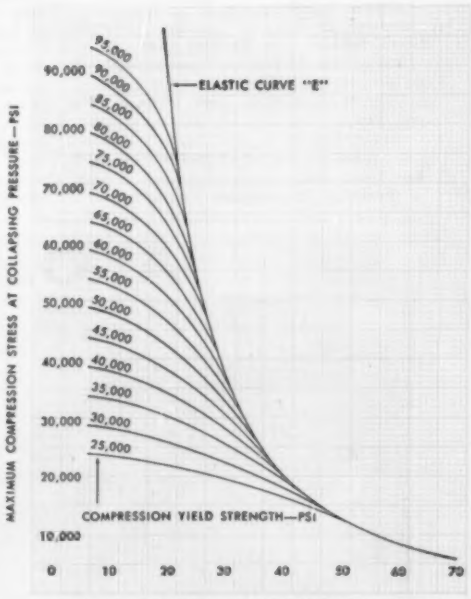
BASIC RESEARCH — The Jasper curves for collapse stress, shown on the right, are the basis for the published minimum collapse values for A. O. Smith casing.



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APPLIED RESEARCH — The above photo shows a specimen being removed after collapsing during the original test program to establish the Jasper curve. A continuous collapse testing program still confirms the data originally developed.

DESIGN — A. O. Smith uses its electronic computer as a modern tool in establishing sound and accurate casing string design.

Turn page to see . . .

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PIPELINE CONSTRUCTION

Project: 7 miles of 4-in. gathering lateral in northwestern Colorado.
Status: Planned.
Completion: July 1, 1958.

Canadian Crude-Oil Pipelines

- **Act Oils, Ltd.**

Project: A 450-mile line from the Peace River region of northern B. C. to tidewater at Bella Coola, B. C.
Status: Request has been made for permit from the B. C. government.

- **B-A Alberta Pipe Line, Ltd.**

Project: 35 miles of 8-in. to connect Drumheller field, Alberta, with existing lines running to Edmonton.
Status: Pending approval.

- **Bituminous Oil Pipeline Co.** (Royalite Oil Co. and Can-Amera Oilsands Development, Ltd.)

Project: 250-mile line from Athabasca oil sands in northeastern Alta., to Edmonton.
Status: Long-range plans.
Completion: 1960.

- **East Coast Transmission Co.** (Pacific Petroleums, Ltd., Home Oil, Ltd., Canadian Homestead Oil, Ltd., Merrill Petroleums, Ltd.)

Project: Line from Alberta to Montreal.
Status: Proposed.

- **Gibson Petroleum Co., Ltd.**

Project: 25 miles of line from Willesden Green field to near Rimbley, Alta.
Status: Has Alberta Government approval.

- **Interprovincial Pipe Line Co.**

Project: 82 miles of 24-in. loops in Alta. and Sask.
Status: Planned.
Contractor: **Piggott Construction, Ltd.**, Edmonton, Alta.

- **Westcoast Transmission Co., Ltd.**

Project: Line to parallel its 650-mile, 30-in. gas line from Peace River to Vancouver, B. C.
Status: Under study.

- **Westspur Pipe Line Co.**

Project: 20 miles of 12-in. from Alida in southeastern Saskatchewan, to the Carnduff-Glen Ewen area to tap Cantal, Hastings, Florence, Carnduff, and Glen-Ewen fields; 34 miles of 4, 6, 8-in. gathering lines.
Status: Has requested permit from Board of Transport Commissioners.
Contractor: **Majestic Contractors, Ltd.**, Jeff Minter, supt., office in Estevan, Sask.
Completion: No date set.

Canadian Products Pipelines

- **Hydrocarbons Pipeline Co.**

Project: 800 miles of 6 and 8-in. L.P.G. line from near Edmonton, Alta., to Fort William, Ont.
Status: Has permit from Parliament of Canada. Seeking approval by Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board.
Construction consultants: **Dutton-Williams Brothers, Ltd.**, and **A. D. Little Co.**

Canadian Natural-Gas Pipelines

- **Alberta Gas Trunk Line Co., Ltd.**

Project: 637 miles of 34 to 16-in. gathering lines in Alberta.
Status: Under way.
Contractor: **Dutton - Williams Brothers, Ltd.**, has preliminary studies, design and management - engineering. **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., jointly with **Marine Pipeline & Dredging Co.**, has crossing of Red Deer River near Cavendish, Alta., J. Hysuick, spread superintendent, office at Empress. **Fulton Banister, Ltd.**, has completed 17 miles of 34-in. west from Burstall, Sask., to near Cavendish, Alta., and 100 miles of 18-in. north to Bindless and Provost fields, **Piggott Construction, Ltd.**, Calgary, has 145 miles of 24-in. south lateral from main junction north of Brooks to Pincher Creek field, including 11 major canal crossings. **Banister Construction Co.**, Edmonton, has crossings of the Old Man, Bow, and Red Deer rivers.

- **Alberta & Southern Transmission Co., Ltd.**

Project: 1,300 miles of 36-in. from Alberta to San Francisco area plus 47 miles of gathering lines.
Status: Planned.

- **Canadian Western Natural Gas Co., Ltd.**

Project: 58 miles of 16-in. from Carbon field to Calgary, Alta.
Status: Proposed. Pending approval of Alberta Oil and Gas Conservation Board.

- **Northern Ontario Pipe Line Crown Corp.**

Project: 675 miles of 30-in. from the Ontario-Manitoba border to near Kapuskasing, Ont. (part of the 2,250-mile Trans-Canada line; will be leased to Trans-Canada Pipe Line Co. with option to buy). 360 miles from Port Arthur to Kapuskasing remains to be laid in 1958.
Status: Under way.
Contractor: **Nelen, Ltd.; Majestic Contractors, Ltd.; B. C. River Construction, Ltd.**, has 91 miles from Longlac to Hurst, E. L. Maggard, supt., office at Longlac, to complete October 1; **Mannix, Ltd.**, has 92 miles from 35 miles west of Hearst, Ont., to Kapuskasing, Odis Hare, supt., office at Hearst; **Morrison Shivers, Ltd.**
Completion: November 1958.

- **Northwestern Utilities, Ltd.**

Project: 72 miles of 16-in. from Pembina field to Edmonton, Alta., and 47 miles of 4 to 16-in. gathering lines.
Status: Under way.

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PIPELINE CONSTRUCTION

Contractor: **Mannix, Ltd.,** has 45 miles of main line, plus the gathering system and the North Saskatchewan River crossing, S. Steffen, supt. of gathering system activities, office at Drayton Valley.

Completion: 1958.

• **Saskatchewan Power Corp.**

Project: Major expansion of its system serving Hatton gas field in Saskachewan, to include 90 miles of 14-in. from Hatton to join line from Success to Moose Jaw, and 40 miles of 12-in. extension from Regina to Moose Jaw.

Status: Planned.

• **Trans-Canada Pipe Lines, Ltd.**

Project: 491 miles of 30-in. from Kapuskasing to Toronto.

Contractors: Starting at Kapuskasing and going toward Toronto, **Grayco Contractors, Inc.,** has 82 miles; **Majestic Contractors, Ltd.,** has 83 miles; **Dutton-Williams Brothers, Ltd.,** has 57 miles; **Canadian Bechtel, Ltd.,** has 47 miles from Rib Lake to Tilden Lake, H. F. (Hank) Mogg, general supt., office at Timagami; **Morrison-Shivers, Ltd.,** has 62 miles; **H. C. Price Co.** and **Poole Construction Co.** has 63 miles; **Oklahoma Pipe Line Constructors** has 92 miles.

Completion: October 1, 1958.

• **Westcoast Transmission Co., Ltd.**

Project: 42 miles of 20-in. and 100 miles of 30 in. from Savanna Creek area, Alta., to Canadian-Idaho border.

Status: Planned.

Completion: November 1, 1958.

Project: Looping of present system to double capacity.

Status: Planned.

Project: 80 miles of 8, 10, 12, 18, 20-in. extension of gathering system along Alaska Highway in Northeastern B. C.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.,** Doyle Cook, asst. supt., office at Dawson Creek.

Completion: August 1958.

Foreign Crude-Oil Pipelines

• **Arabian American Oil Co.**

Project: 9 miles of 32-in. loop from Abqaiq toward Shedgum.

Status: Planned.

Completion: 1960.

Project: 17 miles of 32-in. extension of loop from Abqaiq toward Shedgum.

Status: Planned.

Completion: 1961.

Project: 9 miles of 30-in. extension of loop from Abqaiq toward Shedgum.

Status: Planned.

Completion: 1960.

Project: 12 miles of 30-in. extension of loop from Abqaiq toward Shedgum.

Status: Planned.

Completion: 1961.

Project: 54 miles of 30-in. loop of Safaniya-Ras Tanura line.

Status: Planned.

Completion: January 1959.

Project: 63 miles of 30 and 32-in. from Khursaniyah to Ras Tanura.

Status: Planned.

Completion: January 1960.

• **Assam Oil Co.**

Project: 600 miles of 20-in. from Nahorkatiya field in Upper Assam to Barauni, India, to connect with Burmah Oil Co.'s proposed 250-mile line from Barauni to Calcutta.

Status: Survey of possible routes under way.

Contractor: **Pipe Line Engineering Co.** is making survey.

• **Bolivia-Paraguay.**

Project: 500 miles of 6-in. from Southeast Bolivia to a proposed refinery on Paraguay River, and later to Asuncion.

Status: Planned .

Contractor: **Five Lilles,** a French Combine.

• **Burmah Oil Co., Ltd.**

Project: 250 miles of 20-in. from Barauni to Calcutta, India, extending Assam Oil Co.'s proposed line.

Status: Survey under way.

Contractor: **Collins Construction Co.** is surveying locations for some 40 river crossings.

• **Caltex**

Project: 30 miles of 30-in. from Duri field in Sumatra to Dumai where a deepwater terminal will be built. Line will be extended 35 miles to Minas field later.

Status: Under way.

Contractor: **Bechtel Corp.**

Completion: May 1958.

• **Cia. Shell de Venezuela**

Project: 34 miles of 16-in. from Boscan to site of a planned terminal at Puerto Miranda, Venezuela.

Status: Planned.

Contractor: **Williams Brothers Sudamericano, Ltd.**

Project: 70 miles of 30 and 34-in. heated line from Bachaquero to Puerto Miranda, and an unheated 31-in. parallel to the section from Cabimas to Puerto Miranda.

Status: Planned.

• **Colombian Petroleum Co.**

Project: 42 miles of 6-in. from Tibu field to Rio de Oro in Colombia.

Status: Under way.

• **C.R.E.P.S., Societe Nationale de Recherche et d'Exploitation des Petroles en Algerie (SN Repal), and Cie. Francaise des Petroles Algerie**

Project: 450 miles of 16-in. from Edjele field in southeastern Algeria to a Mediter-

(Continued on page 167)

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New drilling concern

Aspen Drilling Co. is starting operations in the Four Corners area of Utah, Colorado, New Mexico, and Arizona.

Its general manager is W. R. (Bill) Johnston, who until recently was manager of production operations for Northwest Production Co., Albuquerque. He held the same position with Pacific Northwest Pipeline Corp., predecessor to Northwest Production. Prior to that, he was West Texas division drilling engineer for Humble Oil & Refining Co., at Midland.

His father, J. C. Johnston, now regional manager of Continental Oil Co.'s production department at Denver, will become associated with his son in the new drilling company next August. At that time, he will retire from Continental, with which company he has been connected more than 39 years, serving in Oklahoma, New Mexico, Texas, and the Rocky Mountain states.

The elder Johnston's daughter, Mary, Denver oil and gas attorney, is secretary of the new company.

Aspen is starting with two rigs. One is a National T-32, and the other a T-12.

The younger Johnston will be located in the company's Albuquerque office, at 3010 Monte Vista Boulevard, N.E. His father will headquarter in their Denver office, at 205 Petroleum Club Building, when he joins the firm.

Who's getting the drilling contracts?

Pioneer Oil & Gas Co., New Orleans, has a contract operation under way for Seaboard Oil Co. at a wildcat location in southwestern Marion County, South Mississippi. Location is about 1½ miles west of Hub field on Seaboard's Sellers lease, in 24-2n-13e. A 9,500-ft. test to the top of the Lower Cretaceous is planned.

Salt Dome Drilling Co., Houston, will be the contractor on Gulf Oil Corp.'s new offshore wildcat operation in Block 131, South Timbalier area, Gulf of Mexico. The projected test, scheduled to go to 8,000 ft., is about 25 miles from shore, off Lafourche Parish, Louisiana.

Rusty Walters Drilling Co., Bakersfield, Calif., has contracted for a wildcat test to be drilled for San-Cal Oil & Gas Corp., of Sacramento, in the Linden area, near Wallace, in San

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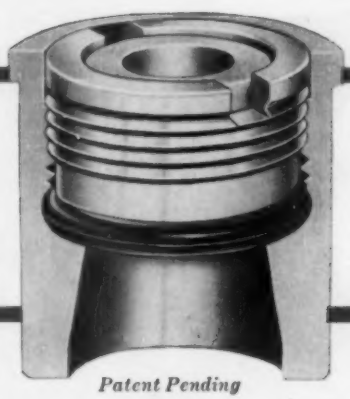
CUT-AWAY VIEW OF **NEW** THREADED FLOW NOZZLE



Patent Pending

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Joaquin County, in far-northern California. Location is at 1 Ospital, in 15-3n-9e, about 1 mile west of the Calaveras County line. Nearest production, gas, is about 12 miles northwest in Lodi field.

Miracle & Wooster Drilling Co. is getting started on a new deep contract job in Lewis County, Washingtoon. Drilling is for J. W. Tanner on a "farmout" from Continental Oil Co. An 8,000-ft. Eocene test is planned. Location, designated as Pleasant Valley Gas & Oil Co.-J. W. Tanner et al 1 Gunther, is about 10 miles southeast of Chehalis. Location is about 70 miles southeast of Sunshine Mining Co.'s oil discovery last year at Ocean City.

Big Six Drilling Co., Houston, is getting started on a new deep wildcat test it has contracted to drill for C. C. Steinberger and associates in Colorado County, Texas Gulf Coast. Its location is about 9 miles northeast of Eagle Lake at 1 Kaechele, in the Mrs. M. E. Conlee Survey. Operators plan a 10,300-ft. test.

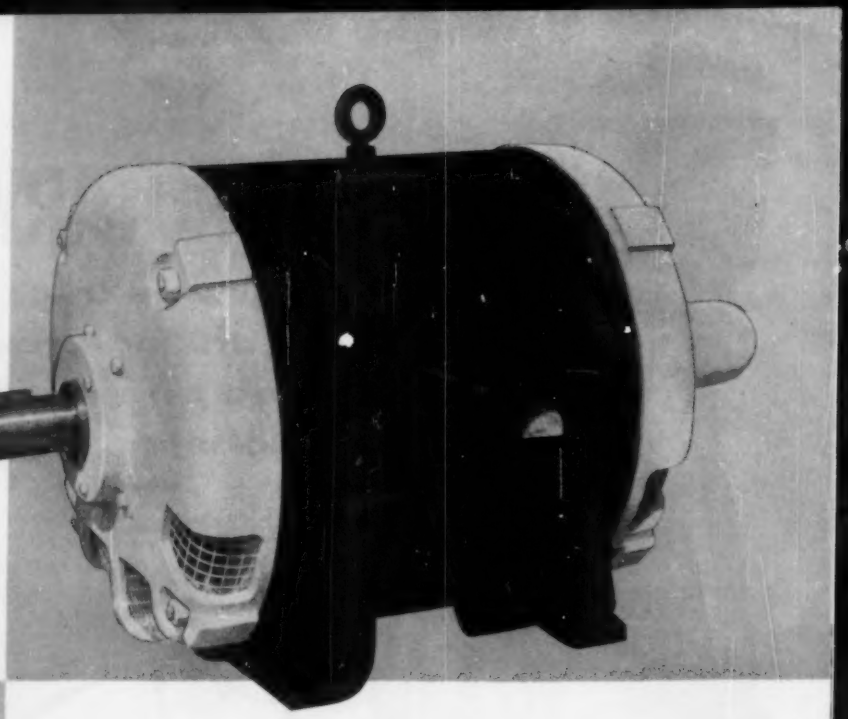
LaGrange Petroleum Co., Shreveport, has moved a rig to a wildcat location 3 miles northeast of Woodville, in Wilkinson County, southwestern Mississippi, for an 8,500-ft. test it has contracted to drill for George B. Christmas, of Texarkana, Ark. The new operation is listed as 1 Christian. Location is in 18-2n-1w.

Stewart & Gouger Drilling Co., San Antonio, will drill an ultra-deep wildcat test for Continental Oil Co. in the Lake Raccourci area, of Timbalier Bay, in Lafourche Parish, Louisiana. Plans call for drilling to 17,000 ft. It is barge operation with location on State Lease 3,260, in Township 21s-21e.

George W. Graham is contractor on a deep wildcat test Cyprus Oil Co., of Houston, is starting about midway between Iota and Grand Coulee fields, in northern Acadia Parish, South Louisiana. The test, 1 Andrepont, is about 2 miles from production. It has a 10,500-ft. permit.

Southland Drilling Co., San Antonio, is lined up to drill another 7,000-ft. test for Hillcrest Oil Co. in the new Bob Cooper area, 14 miles southwest of Falfurrias, in northern Brooks County, South Texas, as soon as it finishes the Hillcrest test it now is on. Both jobs are on Hillcrest's Jack Casey lease slightly less than 2 miles southwest of Bridwell Oil Co.'s oil-discovery well of Bob Cooper field.

Continental-Emsco Green Triangle ELECTRIC PUMPING MOTOR



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SAVE ON MAINTENANCE COSTS There's a built-in BALANCE METER on these motors that makes it easy to maintain good counterbalance. This lessens wear-and-tear on well equipment, reduces maintenance and costly downtime. A pumper can tell *at a glance* if the well is pumping satisfactorily. Neither an engineer nor special instruments is needed. Other *exclusive* design characteristics give cushioned peak demands for increased life of belts . . bearings . . well equipment.

SAVE ON POWER COST By checking the balance meter for uniform needle readings, the pumper is assured of maximum lifting efficiency at the lowest possible electrical cost. Motor has 5-8% slip and 275% starting torque with 1.15 *guaranteed* service factor . . 40°C rise. This can lower peak current demands and power costs.

SAVE ON INSTALLATION COSTS All the flexibility you need for easy, fast installation is incorporated in these motors. Double shaft extension is standard. Motor drives from both sides . . rotates in either direction . . leads can enter from one side or the other. An oversized, diagonally-split conduit box provides plenty of room for power line connections. Hold-down bolt holes are 21/32" *for every motor size*, so bolts furnished with unit pumper can be used . . regardless of type or manufacture.

Many other features make C-E Green Triangle Electric Pumping Motors *completely oil field* . . from the base up. Weather-guarded frame and uni-directional air cooling system assure maximum efficiency under all weather conditions. Sizes from 3 through 30 horsepower are available.

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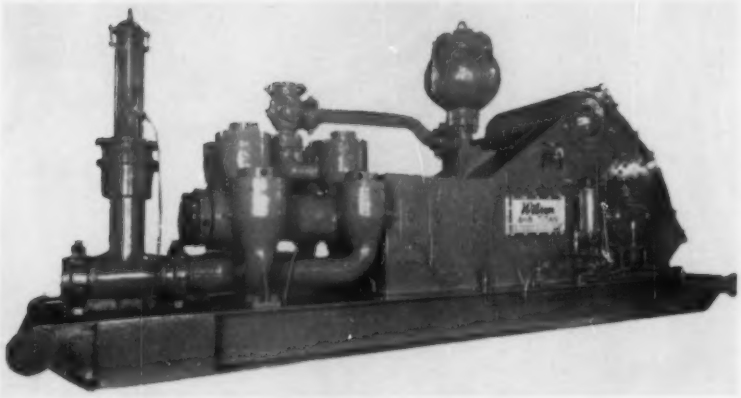
NEW EQUIPMENT



Mud pump employs chain drive

Features of the Wilson Titan mud pump include a chain-and-sprocket drive and self-aligning bearings. Pressure lubrication is employed. All bearings and other wearing parts are pressure lubricated with clean filtered oil for long trouble-free life. To eliminate trouble caused by "washouts," a "whistle alarm" sounds if the liner packing leaks.

Specifications of the mud pump include: (1) an 8-in. bore and 18-in. stroke, (2) maximum rod load of 83,400 lb., (3) maximum pressure with a full-size liner of 1,660 psi., (4) a rated delivery of 1,000 g.p.m. at 75 s.p.m., (5) welded-steel frame material, (6) alloy-steel material for the mud end, (7) quick-removable valve covers and cylinder heads, (8) outside-located suction valves, (9) fabricated alloy-steel crankshaft, and (10) roller crankshaft bearings.

Length of the pump is 240 in., width over frame is 44 in., and height from floor to top of gear case is 84 in. Discharge test pressure is 8,200 psi. and suction test pressure is 3,000 psi. Weight is 35,300 lb. **Write or call: Wilson Manufacturing Co., Inc., Wichita Falls, Tex., for details on Titan mud pump.**

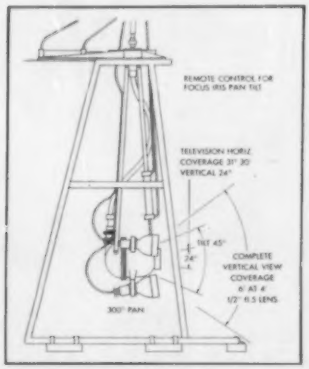
●

Underwater TV Probes 1,000 Ft. Deep

Suited for use in offshore drilling work and called the Medearis underwater TV, it comes as a complete assembly. Successfully operated at 600 ft., it is designed to withstand the pressure encountered at depths to 1,000 ft.

Each complete assembly is customized to meet individual or special requirements. But all electronic components—including remote control, monitor, and television camera—are standard, off-the-shelf items requiring no modification.

Both the remote control and monitoring units are located above the water. They may be on board a drilling barge or wherever else the operator may desire the control point. A watertight, pressure-tested, camera housing encloses the TV camera.


REMOTE CONTROL FOR FOCUS IRIS PAN TILT
TELEVISION HORIZ COVERAGE 31° 30' VERTICAL 24°
TILT 45°
24" I.R.
COMPLETE VERTICAL VIEW COVERAGE 6' AT 4' 1/2" 6.5 LENS
300° PAN

A remote-indicating leak detector warns the operator of any moisture within the housing. Illumination is by floodlights. These mount on the outside of the camera housing.

Remote-controlled motors within the housing operate the focus and iris settings of the camera lens. Similarly, remote hydraulic controls activate rams that provide up to 300° pan and 45° tilt of the entire camera, housing, and lighting assembly. **Write or call: Medearis Oilwell Supply Corp., P. O. Box 449, Torrance, Calif., for details on underwater TV.**

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Described in OIL AND GAS JOURNAL - Issue of March 31, 1958

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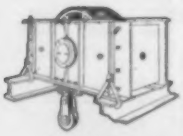
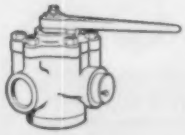
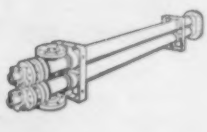
Mounting generator components of the ALCO *diesel-electric drilling power package at Beaumont, Texas. With complete engineering and assembly in the oil country,* ALCO *now offers higher efficiency and better service to drillers.*

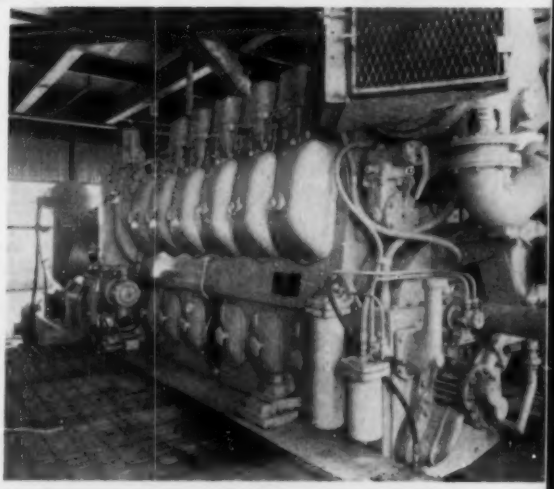
ALCO DIESEL ELECTRIC DRILLING PACKAGES NOW ASSEMBLED IN TEXAS



Crown and travelling blocks • Oil-field valves • Wellhead equipment • Kinney plug injectors • Finned tube products

Simplest controls of any drilling power package are provided by ALCO. *Simple handwheel or similar arrangement controls generator output. All drilling operations are controlled from same position. There's less time required to train driller, less chance of errors.*



Heart of ALCO *drilling power is turbocharged 251 diesel. Engine delivers high performance with reduced maintenance and fuel consumption. Electrical equipment is specifically designed for the 251 diesel and combines with it to produce the most efficient drilling power available.*

ALCO has now assigned complete responsibility for engineering, assembly and service of its diesel-electric drilling power package to its Beaumont, Texas, plant. From this move you get these unique advantages, unmatched in ALCO'S horsepower range: (1) local supply by the equipment *manufacturer,* (2) integrated design of controls, rotating equipment and engines by people *who know drilling problems,* (3) quick and dependable service from a *local source.*

Three years of field use have already proved that ALCO diesel-electric packages are the most reliable, trouble-free and flexible source of drilling power. The four-cycle, turbocharged 251 diesel engine has an excellent maintenance record, and savings in fuel average 10 per cent over comparable engines. Electric controls and rotating equipment are designed specifically for the ALCO engine. The power package is completely self-contained: No additional power source, a-c or d-c, is required to operate any part of the rig.

Field engineers trained in the operation and maintenance of the 251 diesel and its rotating equipment and controls are located in Houston, Beaumont, New Iberia and Biloxi. All parts are stocked in Beaumont and Odessa. For Bulletin DE-7 with complete information write ALCO Products, Inc., Petroleum Industry Equipment Division, Dept. 181, Bank of the Southwest Building, Houston 2, Texas.

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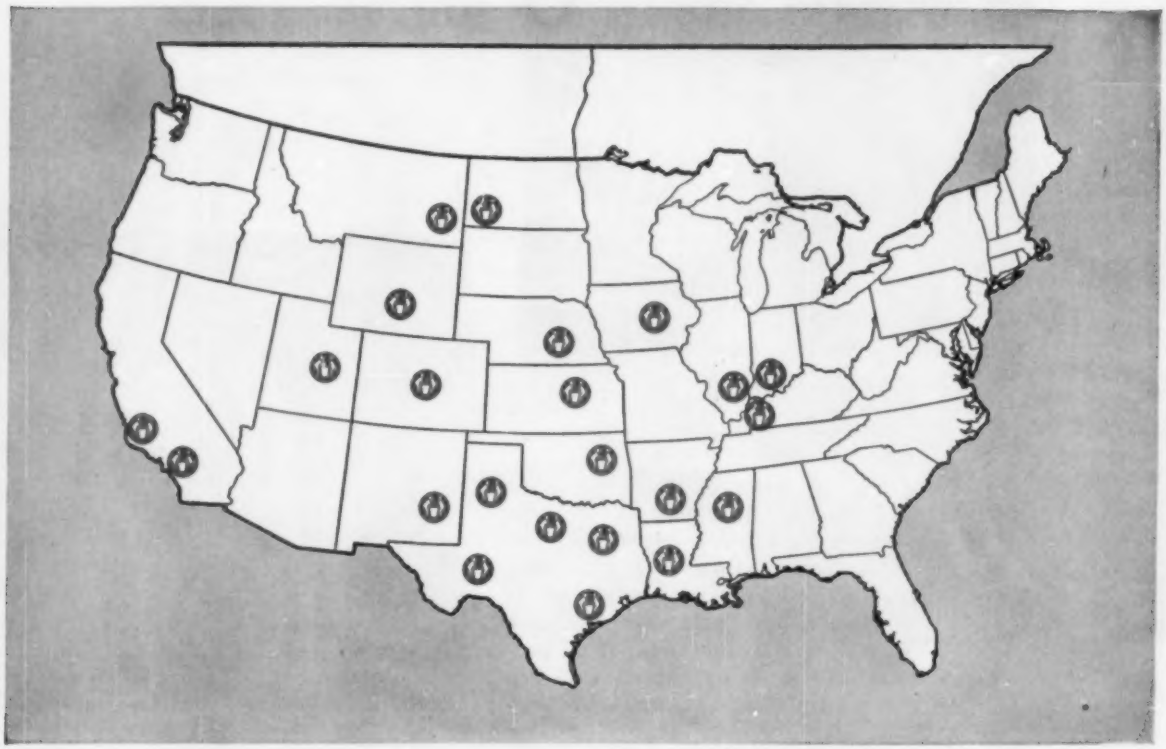

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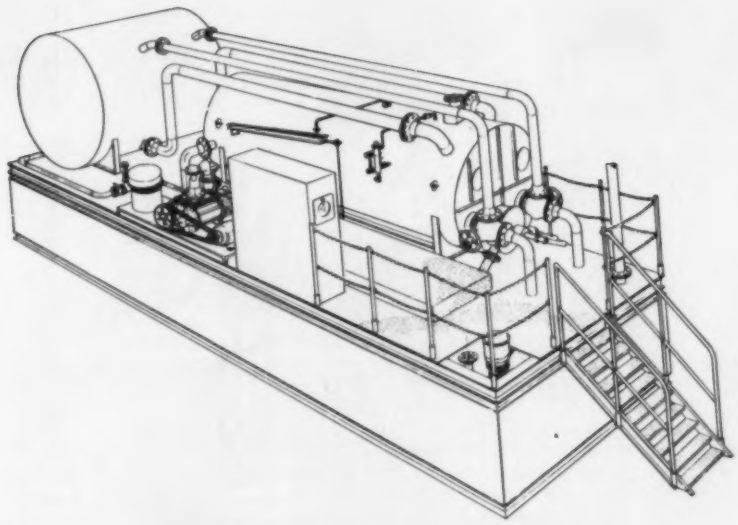
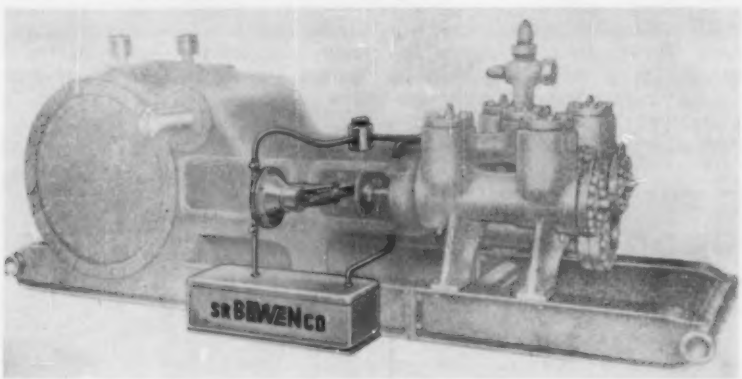


Sulfur-recovery unit installs easily

The new Tears sulfur-recovery unit is designed to convert H_2S (acid gas) to molten sulfur of high purity.

The complete, shop-assembled unit can be shipped to any desired location and quickly installed on a concrete pad simply by connecting it with a supply of electric power and the acid gas, according to the maker.

Estimated plant payout period, even for small units, is from 1½ to 2½ years, depending upon local costs and conditions, according to the company. The sulfur-recovery unit is licensed by Pan American Petroleum Corp. **Write or call: Tears Engineers, 4617 Cole Avenue, Dallas, for details on sulfur-recovery unit.**



Pump-rod oiler is selfpriming

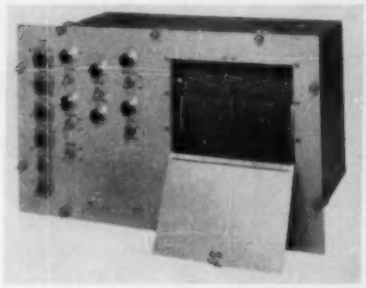
Built to lubricate slush-pump rods, the oiler is applicable as original lubricating equipment on new slush pumps or as a replacement for defective or wornout lubricators on pumps now in use. It furnishes a constant, even flow of clean oil to the rods to keep them free of abrasive elements. And it is easily installed on any type or size of reciprocating pump.

Such elements of present lubricators as oil reservoirs and lines may be used. A complete lubricator system, consisting of pump-rod oiler, reservoir, accumulator, and necessary connecting lines can be obtained.

The Bowen pump-rod oiler is a diaphragm type of positive-displacement pump. It consists of an activating lever, mounting bracket, cup, spring, diaphragm, diaphragm washer, and check valves. It displaces from 0.04 to 0.08 gal. per mud-pump stroke. **Write or call: S. R. Bowen Co., 11008 South Norwalk Boulevard, Santa Fe Springs, Calif., for details on pump-rod oiler.**

Magnetic-Tape Recorder Makes 24 Seismic Records

Known as Geocord, the recorder is designed for geophysical seismic work. It features transistors and portability. The field unit produces 24-channel, magnetic seismic records, the maker says. The cases contain the complete recording system. Each weighs 45 lb.

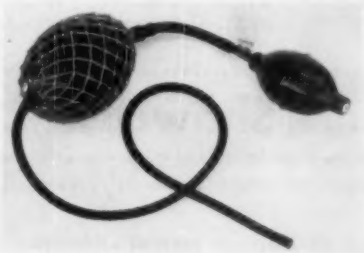


The recorder is hermetically sealed at every possible point, the maker adds, to make it water and dustproof. **Write or call: General Geophysical Co., Houston Club Building, Houston 2, for details on Geocord tape recorder.**

●

Pressure Bulb Aids Field Test of Orifice Meters

Uses for the manometer pressure-bulb assembly include field testing of orifice meters, low-pressure regulators, low-pressure gages, liquid levels, and



sources of low-pressure air. The pressure-bulb assembly consists of: (1) a hand-pressure bulb equipped with a small bleeder valve, (2) an expansion reservoir protected by a heavy silk net, and (3) the connecting rubber tubing.

The bleeder valve allows an operator to accurately control reducing pressure at any selected point simply by opening and closing the fingertip-control needle valve. Pressures to 100 in. of water are easily reached by use of the hand bulb. **Write or call: W. H. Curtin & Co., 1800 Sidney, Houston 1, for details on manometer pressure-bulb assembly.**

Magnetic Ball Check Developed For Gas-Lift Valve

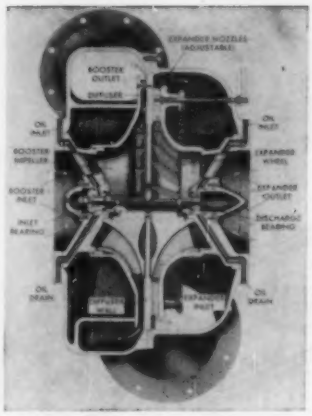
The magnetic ball-check valve is designed primarily as a component of Brown gas-lift valves. But many additional uses are possible. The valve is made from noncorrosive nickel alloys. The ball is produced from titanium carbide with a nickel binder. The cage is of monel metal. Permanent magnets are inset inside the walls of the cage, three on either side.

The ball remains at the upper edge of the cage, except when it's forced down by pressure to allow gas to pass. Long travel of the ball without a corresponding reduction in return force is one of the novel features of the magnetic cage. The valve may be used in any position in any application or assembly, the maker says. **Write or call: Harold Brown Co., 2417 Bissonnet, Houston, for details on magnetic ball-check valve.**

●

Turbine Cooler For Engines Ups Horsepower Output

The turbocooler is used to cool engine-combustion air which provides potential means for increasing horsepower output of gas or gas-diesel



engines. According to the maker, horsepower output can be upped as much as 23%. At the same time, fuel use is reduced as much as 5%.

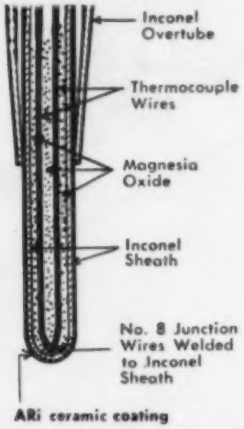
Basically, the turbocooler is a turbine-driven centrifugal compressor equipped with an aftercooler. It permits use of the energy created by a pressure drop in the manifold to cool combustion air. **Write or call: Cooper-Bessemer Corp., Mt. Vernon, Ohio, for details on turbocooler for gas and gas-diesel engines.**

●

Thermocouple Is Electrically Insulated From Well

The new Green Tip thermocouple offers an unusual combination of features. These are: (1) fast time response, (2) a magnesium oxide-insulated thermocouple welded integrally with the sheath, and (3) a thermocouple electrically insulated from the thermowell or overtube, the maker reports.

These features are accomplished by use of a ceramic coating between the sheath and overtube. This coating



provides an operating temperature range from 320° to 1,900° F. and a pressure range from high vacuum to 2,000 psi. Other features cited are resistance to erosion, corrosion, and nuclear radiation. **Write or call: Aero Research Instrument Co., Inc., 315 North Aberdeen Street, Chicago 7, for Data Sheet 385.**

●

Portable Logger Fits In Car Trunk

The portable Geo-Logger is especially designed for electric and gamma-ray logging on seismic and shallow core holes.

Other features of the shot hole Geo-Logger are: (1) a powered-cable hoist, (2) an armored-steel, single-conductor, logging cable, and (3) interchangeable components that make various types of logging possible with a single unit. The new logger comes as a "turn key" package complete with a portable, gasoline-driven generator and all accessories. **Write or call: Well Reconnasisance, Inc., 7818 Brook Hollow Road, Box 1483, Dallas, for details on portable Geo-Logger.**

Send this **Showcase Coupon**

to the **Manufacturer** of the item in which you are interested. See name, address, and equipment name and/or model, in bold-face type at end of description.

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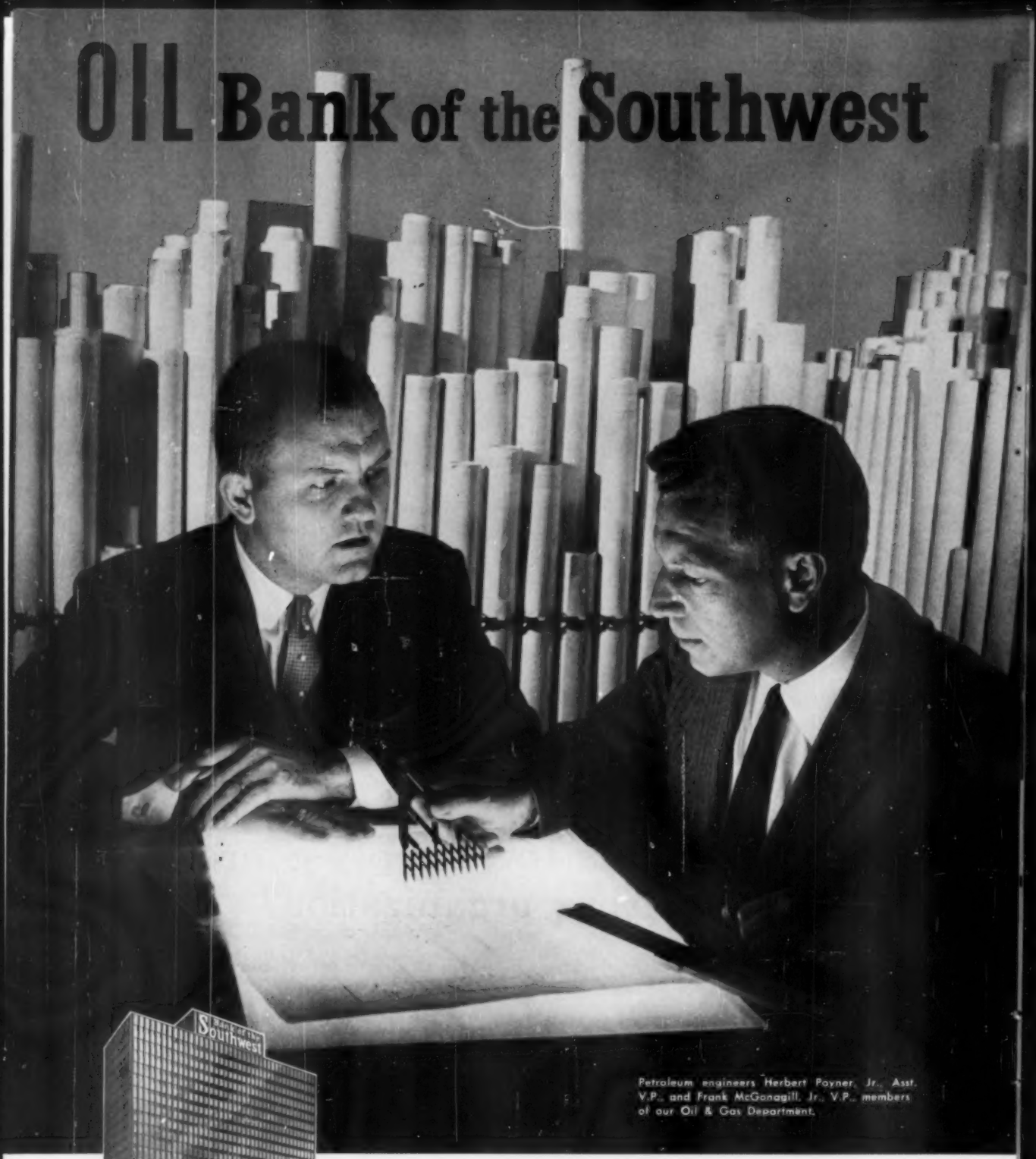

Petroleum engineers Herbert Poyner, Jr., Asst. V.P., and Frank McGonagill, Jr., V.P., members of our Oil & Gas Department.

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BANK OF THE SOUTHWEST offers the ultimate in scope and quality of financing to the petroleum industry. The seasoned members of our Oil & Gas Department were oil men before they were bankers. A large number of our directors and Advisory Committee also are oil men. That's why our bank is known as the Oil Bank of the Southwest. For information, write Harold Vance, vice president and manager, Oil & Gas Department.

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New Literature

Optical plummet transit . . .

operation and adjustment instructions are included as a special supplement to the new 1958 edition of the Gurley Ephemeris. Complete step-by-step details are given for using the optical plummets. The ephemeris also features charts which will simplify the computation of Polaris. The annual publication also includes an almanac, listing 28 selected stars for determining stellar observations. It gives complete instructions for determining azimuths by methods similar to those used in observations of the sun and Polaris. The 98-page booklet also contains definitions of astronomical terms and sample problems. **Write or call: W. & L. E. Gurley, Troy, N. Y., for new ephemeris.**

Ring-balance meters . . .

Series 3000 are described is new eight-page Bulletin PM 10002. The bulletin lists performance and specification data. And it contains descriptive text, tables, and illustrations on such accessories as integrators, pneumatic transmitters, and pressure and temperature elements. The basic ring-balance instrument is a flow or differential recorder or indicator used in measurement of gases, vapors, and liquids. It can function as a recorder, indicator, or integrator, or any combination of the three, the maker reports. **Write or call: Hagan Chemicals & Controls, Inc., Hagan Building, Pittsburgh 30, for Bulletin PM 10002.**

Tool joint replacement . . .

is reviewed in a new pocket-sized, 12-page booklet. Designed to help drillers with field maintenance problems, the booklet illustrates two methods of removing worn or damaged double-seal, shrink-thread tool joints. Preparation procedure and equipment, and the equipment and method for replacement of the joints are clearly outlined. The booklet is fully illustrated and includes data for advancing tool joints on drill pipe. **Write or call: Spang-Chalfant Div., National Supply Co., 2 Gateway Center, Pittsburgh 22, for Tool Joint booklet.**

Valve characteristics . . .

of the Barksdale valve line are detailed in new 56-page Catalog 58-59. Featuring a Shear-Seal leakproof principle, these valves are rated for oil and water pressures from 0 to 250; 0 to 1,500; 0 to 3,000; 0 to 6,000; and 0 to 10,000 psi. Air pressures are rated from 0 to 250; 0 to 1,000; 0 to 2,000; 0 to 4,000; and 0 to 10,000 psi., in four-way, three-way, shutoff, and diverter flow patterns, manual, and solenoid. Sections of the bulletin contain simple graphs for calculating pressure drop, discharge, and velocity of liquids. **Write or call: Barksdale Valves, 5125 Alcoa Avenue, Los Angeles 58, for Catalog 58-59.**

Industrial pH equipment . . .

Bullein 5400 gives detailed descriptions and specifications for all Beckman industrial pH instruments, electrodes, and accessories. The eight-page brochure details the operation of the equipment. Photographs and detailed drawings illustrate each section of the equipment. **Write or call: Beckman Process Instrument Div., Beckman Instruments, Inc., Fullerton, Calif., for Bulletin 5400.**

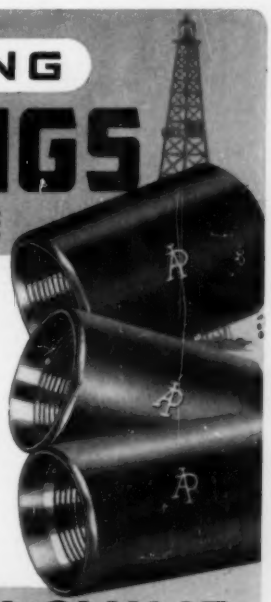
Heat exchanger . . .

of the graphite-block type is discussed in new Catalog 456. It includes specifications and schematic drawings of the model. The graphite used in the exchanger has high thermal conductivity and is inert to most of the cor-

WHEELING

COUPLINGS

FOR OIL COUNTRY USE



LINE PIPE COUPLINGS A.P.I.
1/8" to 12"—Seamless and Special Processed—Black or Galvanized

PLAIN TUBING COUPLINGS A.P.I.
1" to 4"—Seamless

EXTERNAL UPSET TUBING COUPLINGS A.P.I.
2 3/8" to 3 1/2"—Seamless

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HYDRAULIC COUPLINGS
1/8" to 4"—Seamless

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6" to 12"—Seamless

WHEELING MACHINE PRODUCTS COMPANY

WHEELING, WEST VIRGINIA

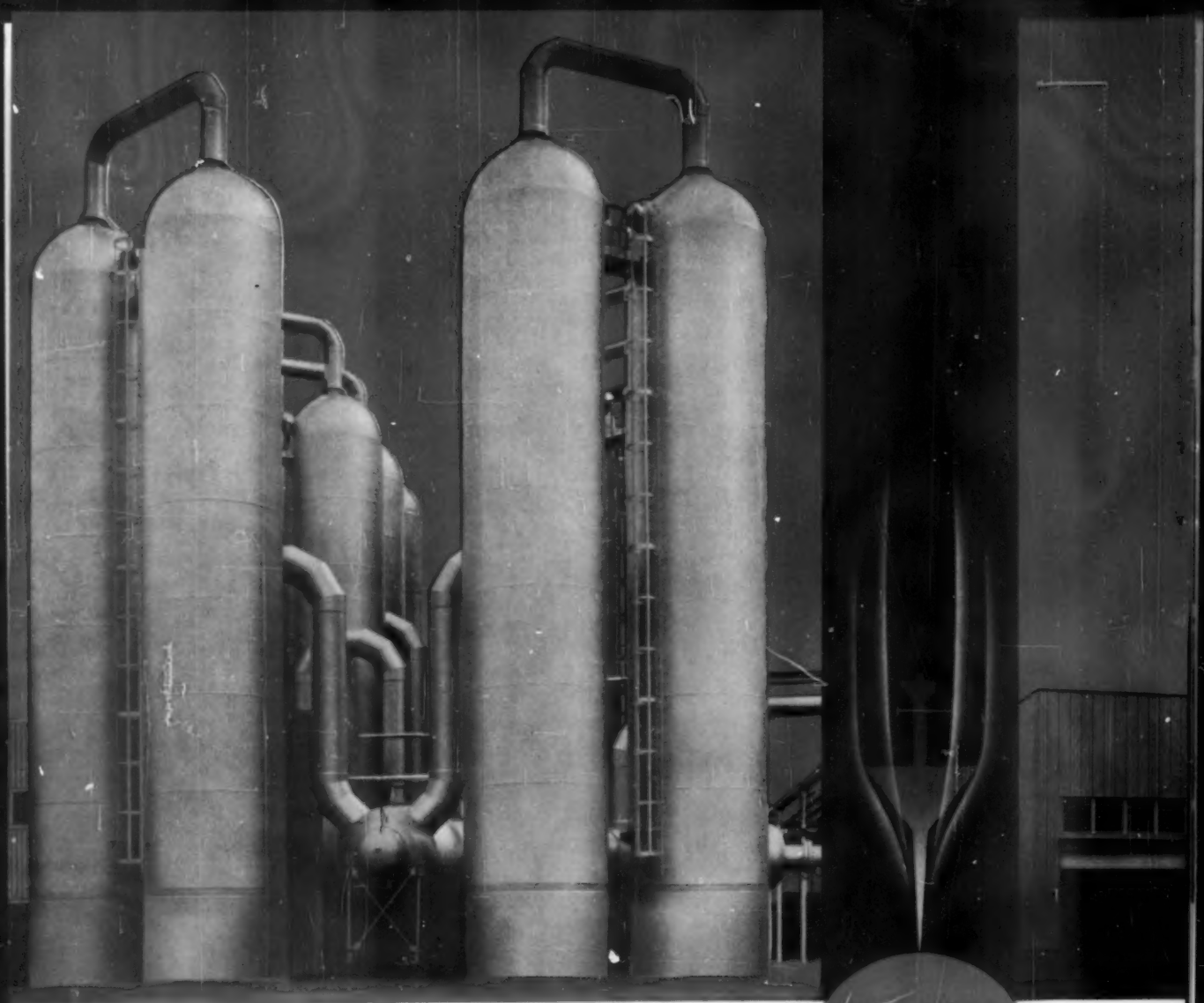
WEST COAST FACTORY: WOODLAKE, CALIFORNIA

X

SALES OFFICES IN LEADING CITIES

Baltimore, Md.—James W. Frankhanel, 2301 N. Charles St.
Chicago, Ill.—Harry A. Jay, Suite 1090, Old Colony Bldg.
Denver, Colo.—W. G. Cline & Co., 4500 Kalamath
Detroit, Mich.—R. W. Lang, Jr., 505 Park Avenue
Erie, Pa.—R. J. Maggi, Box 711
Falmouth, Mass.—Walter S. Bennett, 53 Minot St.
Grand Rapids, Mich.—R. W. Lang, Jr., 138 Burton SE
Houston, Tex.—Henry H. Paris Distributor, Inc., Box 932
Independence, Mo.—Craig A. Fross, 3701 Norwood
Los Angeles, Cal.—James A. Riordan Co., 1400 Santa Fe Ave.
Louisville, Ky.—Sid Schultze Co., 849 So. 6th St.
Milwaukee, Wisc.—W. G. Nelson Co., 3347 N. 97th St.
Narberth, Pa.—Worthington-Grothaus and Assocs., 105 Forrest Ave.
Newark, N. J.—Ira L. Rothenberg & Assocs., 398 Market St.
New York, N. Y.—Max Rothenberg, 11-05 38th Ave., Long Island City
Omaha, Nebr.—Wm. Freiden, Central States Engineering & Sales Co., 5101 Blondo St.
Oswego, N. Y.—Northeastern Associates, Neil Chatterton, Sec'y., P. O. Box 284
Portland, Ore.—J. G. Beard Co., 1233 NW 12th Ave.
Richmond, Va.—P. C. Abbott & Co., 15 E. Franklin St.
St. Louis, Mo.—Walter C. Dollinger Co., 4859 Goodfellow Ave.
Salt Lake City, Utah—Lovell Company, 29 E. 2nd St. South
Seattle, Wash.—Ashe & Jones, 819 Thomas St.

QUALITY-CONTROLLED PIPE COUPLINGS SINCE 1918



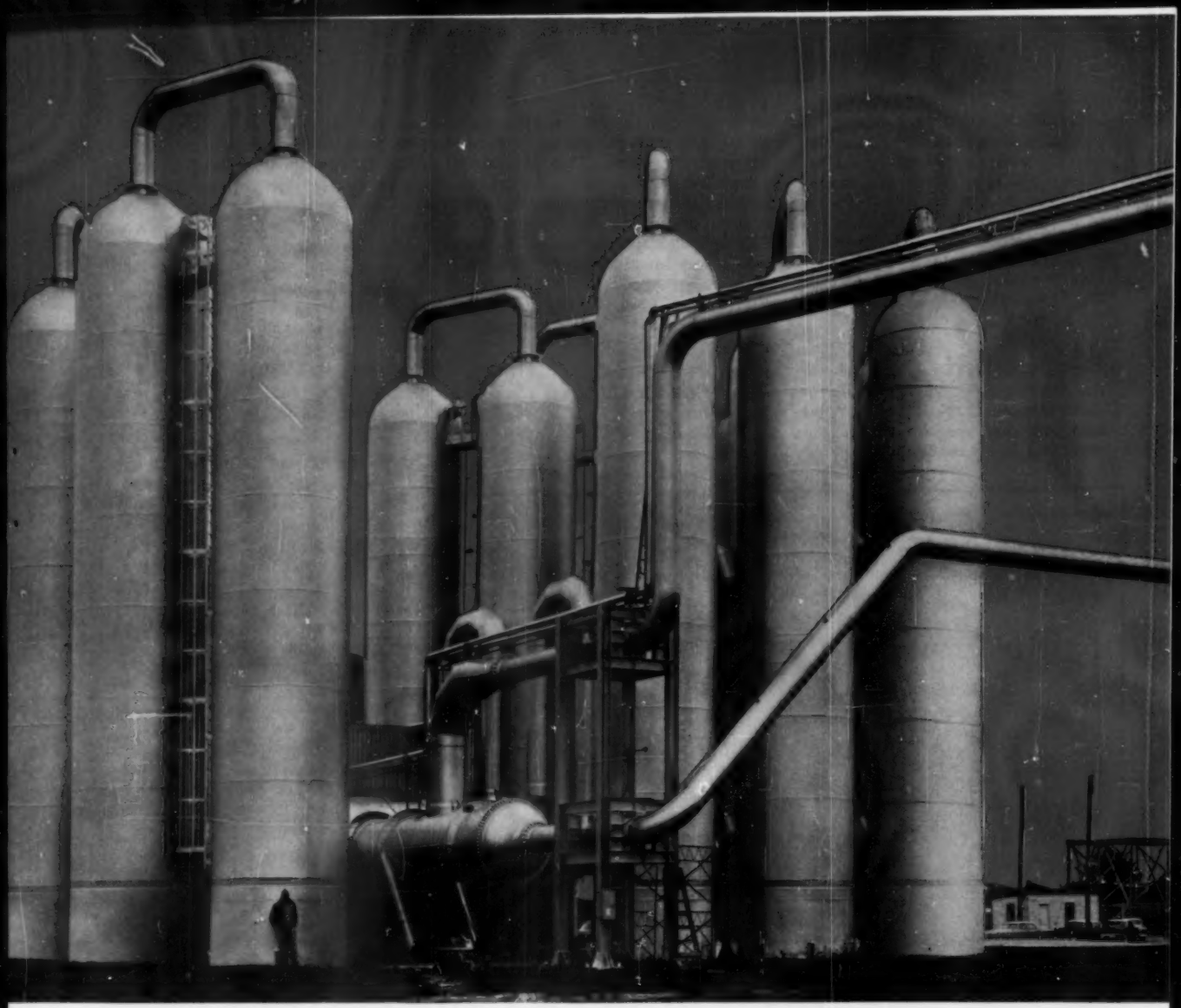
PIONEERING BY PDM

ENGINEERS FABRICATORS CONTRACTORS

America's first big

T-1 STEEL

pressure tank installation



12 tanks, each 63 ft high by 11 ft dia, storing air at 600 psia, for special research application

This first-time application of T-1 high strength alloy steel to tanks working at high pressures has significance to every user of pressure vessels in the process industries. Researched, designed, fabricated and tested by Pittsburgh-Des Moines, the tanks supply air at 600 psia to a 20-inch supersonic blowdown wind tunnel at N.A.C.A.'s Langley Aeronautical Laboratory, Langley Field, Va. ● With total volume, pressure and ground area specified, PDM was required as a bidder to determine the most economical size and number of tanks to do the job. If made of standard boiler steel, the tank walls would have had to be extremely thick to contain the required pressure, and so our previous T-1 experience suggested the use of this high-strength alloy. Our own tests of workability and weldability confirmed the plan, and PDM was awarded the contract at a very substantial saving to N.A.C.A. ● We invite you to make use of our very extensive experience in the most exacting kinds of steel platework fabrication.

Pittsburgh • Des Moines Steel Company

Plants at PITTSBURGH, DES MOINES, SANTA CLARA, FRESNO, and CADIZ, SPAIN

Sales Offices at:

PITTSBURGH (25)	3496 Neville Island	DES MOINES (8)	997 Tuttle Street
NEWARK (2)	1780 Military Park Bldg.	DALLAS (1)	1201 Praetorian Bldg.
CHICAGO (3)	602 First National Bldg.	SEATTLE (1)	Suite 306, 500 Wall St.
EL MONTE, CAL.	P. O. Box 2012	SANTA CLARA, CAL.	603 Alviso Road
ATLANTA (5)	361 E. Paces Ferry Rd., N.E.	DENVER (2)	323 Railway Exchange Bldg.

rosive fluids, the maker reports. It consists of a block of "Delanium" graphite with parallel rows of round holes on the process side, and in alternate horizontal planes. The holes run at 90° angles for the service side. The design makes possible the use of pressures up to 100 psi., the maker says. **Write or call: Delanium Graphite Co., 134 Elmora Avenue, Elizabeth, N. J., for Catalog 456.**

Electric motors . . .

designed with a lifetime seal against chemicals, mechanical shorts, vibration, and dust and dirt abrasion are described in a new bulletin. The motor is guarded against chemical corrosion with pressure-injected molded-polyester insulation. This insulation guards against hot spots, the maker reports, as each individual coil wire is firmly sealed in the protective plastic. And all coils and insulators are sealed permanently into one solid, integral unit. **Write or call: Lincoln Electric Co., 22801 St. Clair Avenue, Cleveland 17, for Multiguard motors bulletin.**

V-belt drive costs . . .

are discussed in a new booklet that also provides new data in calculating the costs. Approaching drive design from the standpoint of "service level" rather than from standard horsepower ratings, the method outlined in the booklet enables the designer to pin down specific annual costs and get a better evaluation of optimum drive design. Belt replacement and lost production costs may be included as essential parts of pumping-unit economics. Engineering data for the design of a drive are contained in a separate design bulletin. **Write or call: Gates Rubber Co., Sales Div., 999 South Broadway, Denver 17, for Bulletins DH-824 and AC-299.**

Large induction motors . . .

are reviewed in new Bulletin 1950 which presents detailed information on a full line of motors in ratings from 150 to 1,250 hp. Motors of this size fill the demands imposed by ever larger process machinery and industrial operations, such as refinery pumps, compressors, and cooling-tower pumps, the maker says. Cutaway drawings and illustrations show the protection offered by the open dripproof, splashproof, enclosed, and explosionproof enclosures in which these motors are built. Bearing design, insulation, and optional features are detailed. **Write or call: Louis Allis Co., 427 East Stewart Street, Milwaukee 1, for Bulletin 1950.**

Quick-opening manways . . .

are described in new six-page Bulletin 576. Two lines are illustrated. Photographs show how the manway is opened from either side by removing one of two heavy-duty pins. The other pin acts as a hinge, permitting full access into the pressure vessel. For 50-psi service, an instant-latch door model is available with a cam lock which prevents accidental opening, yet permits venting of residual pressure before opening, according to the maker. **Write or call: Lenape Hydraulic Pressing & Forging Co., Dept. 245, West Chester, Pa., for Bulletin 576.**

Pump plungers . . .

with a hardened surface and aluminum-bronze replacement parts are illustrated and described in a new two-color folder showing the special design, special coating, and specialized uses. These replacement plungers have a hard-surfaced body attained through a sprayweld process. In field tests, these plungers have reduced maintenance costs up to 40%, the maker says. Custom manufactured hard-surface units can be had. **Write or call: H. L. Dacus Co., 1323 East Fifth Street, Tulsa, for Pump Plungers bulletin.**

33 WEST TEXAS OIL WELLS PROTECTED FROM EXTERNAL CASING CORROSION BY CSI

Two casing leaks in West Texas oil wells cost this company more than $25,000 each. External corrosion proved to be the cause.

The company then decided to protect 33 of its other West Texas wells cathodically. CSI was awarded the job on a competitive bid basis.

CSI engineers—pioneers in well protection work—furnished all the engineering, labor, materials and equipment needed. Rectifiers were used as the applied current source. The job was done in 10 consecutive days for about $330 per well.

You'll find it pays to call CSI for engineering, installation services or quality cathodic protection supplies. Call or write today—quotations or estimates without obligation.

CSI

CORROSION SERVICES INCORPORATED
Tulsa, Oklahoma

P. O. Box 7343, Dept. J-6 **Telephone: Circle 5-1351**

Lone Star Steel Co. Elects F. F. Florence . .

F. F. FLORENCE

as chairman of the board in a momentous meeting of the members of the company's board of directors.

President E. B. Germany distributed copies of the 1957 annual statement which showed a 1957 increase over 1956 in operating revenues, net income, working capital, and earnings per share.

The election of Florence, chairman of the executive committee and chief executive officer of Republic National Bank of Dallas, followed the resignation of C. E. Owens of Tyler, Tex. D. Gordon Rupe investment banker, was elected to succeed Florence as chairman of the finance committee.

Florence is president of American Bankers Association and also past president of Texas Bankers Association. He is a director of Austin Bridge Co., Bond Stores, Inc., Dallas Power & Light Co., Dallas Transit Co., Missouri-Kansas-Texas Railroad, Wyatt Metal & Boiler Works, and the bank which he leads.

Two Changes Made By Oilwell Supply Division . .

according to an announcement by D. S. Grubbs, California area manager of the division.

Edward W. Metters, district representative was transferred from Castaic Junction, Calif., to Long Beach, and Earl J. Collier has been named district representative at Castaic Junction.

Metters was employed by Oilwell in 1950 at Los Angeles and was transferred to Long Beach in 1951. In 1952 he was shifted to Castaic Junction and appointed store manager at that location in 1954. The following year he was appointed district representative there.

Collier was employed by Oilwell in 1956 at Taft, Calif.

Roebuck, Crawford Join Staff of Western Co. . .

A. H. ROEBUCK

as assistant to the manager of research and development department at Midland, Tex.; and as research associate in the research laboratory at Dallas, respectively. The announcement was made by Roscoe C. Clark, Jr., manager of the research and development department.

Dr. A. H. Roebuck will assist in the administration of Western's research and engineering programs. Dr. Horace Crawford will be active in research directed toward the improvement of oil well servicing products and techniques of the company.

Prior to joining Western, Roebuck served as research associate for Argonne National Laboratories in Chicago, and as research group supervisor with Continental Oil Co. at Ponca City, Okla. Before joining the company, Crawford was employed by Sun Oil Co. as a gas engineer.

C. D. Jones Appointed By Delta-Desco . .

to head its special products division for the Gulf Coast area. Jones was formerly a complete line salesman for Delta in this area.

The special products division will include Delta automatic lubricators, electronic alerts, flange seals, packing impregnation, and gate valve stem shields.

Montello, Inc., Organized To Make Mud Additive . .

which is to be distributed through mud dealers throughout the oil country. Two products will be produced by the Tulsa firm, both classified as a lost-circulation material.

Pheno-Seal is a flake while Pheno-Bridge is a granular material. Both are laminated phenolic products. Incorporators of Montello are: Kirby Oesch, Harry Wyatt, Gerald Iott, and Kenneth Campbell.

Six Appointments Announced By National Supply Co. . .

R. L. RITCHEY

for the Northwest division headquartered at Denver. R. L. Ritchey has been appointed division sales manager. He succeeds Albert A. Anderson, who will serve as sales representative, industrial accounts. William C. Hull was named division manager of used equipment sales, succeeding Ritchey. K. E. Curtis was named district manager of the

W. C. HULL

K. E. CURTIS

Wyoming district, succeeding C. W. Morris. Morris will serve as sales representative, handling city sales in Casper, Wyo. G. D. Binks was appointed manager of the Wyoming used equipment yard, succeeding Hull.

Ritchey started with the company in 1950 at the Kevin, Mont., store. Later he served as manager of the Casper store and manager of used equipment sales. Anderson started at Casper in 1924. He served briefly at Calgary, Alta., and has been division sales manager at Denver since 1952.

Hull started in 1955 as field salesman for the Casper store and was named manager of the Wyoming used equipment yard in 1956. Curtis joined the company in 1948 at Cushing, Okla., rising to store manager at Drumright, Okla. He was transferred

Walworth Opens New Building For Central Division . .

in Glenshaw, Pa., a suburb of Pittsburgh. The new building, containing 61,000 sq. ft., will house the company's Central division's sales and distribution for the greater Pittsburgh area, and will also serve customers in West Virginia, most of Ohio, portions of western New York, western Pennsylvania, and sections of Maryland, Indiana, and Kentucky.

The new facilities include modern material handling equipment and truck and railroad shipping areas. Distribution for this division was previously from Greensburg, Pa.

to the Northwest division in 1954 as store manager at Worland, Wyo., and promoted that same year to assistant district manager of the Wyoming district.

Morris started in 1920 at Laramie, Wyo., and has served as store manager at Casper and Rock Springs, Wyo., and Farmington, N. M. He has been district manager of the Wyoming district since 1952. Binks started in 1947 at Casper, where he was promoted to store manager, and has served as city sales representative there since 1953.

Rolo Manufacturing To Make and Sell Fish Dehydrator . .

under terms of an agreement reached with Fish Engineering Corp. of Houston. R. K. Frankin, president of Rolo Manufacturing Co., said the Fish calcium chloride gas dehydrator will be added to the line of equipment Rolo provides to the oil and gas industry.

Models and capacities of standard units cover a variety of applications.

The agreement is signed by Fish's Curt Ames. At left is Rolo's R. K. Franklin.

Using a series of reflux trays and baffles, the calcium chloride unit uses brine from the dessicant bed to strip water from the gas stream prior to passing through the specially compounded calcium chloride pellets.

The dessicant dehydrator was originally designed for extreme low temperature operation at wellhead installations in Rocky Mountain gas fields. Since the initial installation of the units in the Pacific Northwest pipeline production area in San Juan basin of New Mexico, the units have been used in producing areas of Colorado, Wyoming, and also in Canada.

Sperry-Sun Well Surveying Co. Held Sales Meeting . .

for 1958. Those attending were: standing—J. B. Peddy, Mid-Continent sales manager; R. D. Warden, district manager, Casper, Wyo.; S. H. Williston, vice president; W. B. McElreath, safety department, Sun Oil Co., Beaumont, Tex.; Q. B. Marsh, assistant to general manager for sales; A. J. Goolsbee, district representative, Marshall, Tex.; R. R. Blakeley, special sales representative, Odessa, Tex.; E. J. Blackburn, district manager, Houston; J. S. Gosling, manager, Sperry-Sun of Canada, Ltd.; C. C. Littlefield, Jr., district manager, Oklahoma City; J. I. Murph, district representative, Corpus Christi, Tex.; B. A. Cabaniss, Gulf Coast sales manager. Seated are C. E. Hawk, assistant to general manager for manufacturing; R. R. Rice, district representative, Odessa; H. G. Bell, Jr., district representative, New Orleans, La.; H. M. Lowe, district manager, Long Beach; A. B. Palmer, general manager; W. R. Angelle, Jr., district representative, Lafayette, La.; and H. A. Wesner, office manager.

Axelson Manufacturing Co. Opened Service Office . .

and warehouse recently in Long Beach, Calif. The building has approximately 3,000 sq. ft. under roof and additional area for storage. The local hydraulic service manager makes his headquarters at this office, as do five service personnel. This new facility maintains a complete inventory for installation and maintenance of hyraulic pumping units and is part of an expansion program to provide a service organization in major producing areas.

Axelson is a division of U. S. Industries, Inc.

Cardwell Manufacturing Co. Appoints Bill Hubbard . .

as sales representative, Clyde Lackey, domestic sales manager, has announced.

BILL HUBBARD

Hubbard will headquarter at the Odessa, Tex., office and represent Cardwell in West Texas. He was formerly associated with American Iron & Machine Co. as service engineer and sales representative.

Blaw-Knox Co. Appoints Robert L. Merrick . .

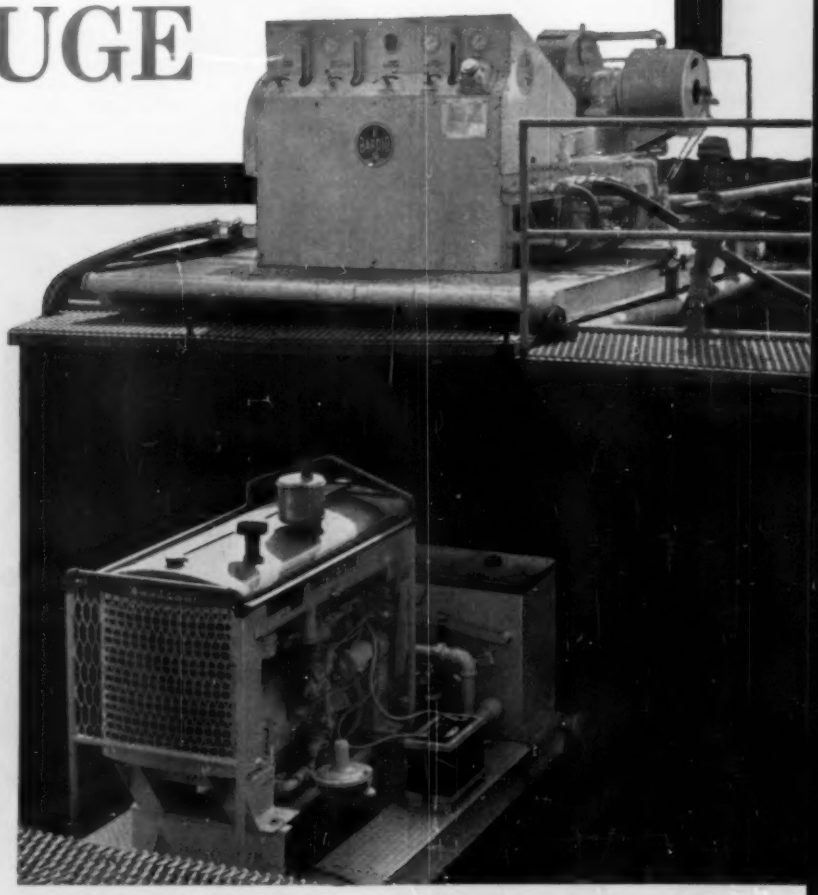
as chief project engineer of its chemical plants division, which provides engineering and construction services to the chemical, petroleum, and allied industries. Merrick will be responsible for general direction of all project engineering.

Merrick joins Blaw-Knox with over 30 years experience in design and construction of process plants and complex structures. He recently served as president and general manager of Petrocon Engineering Co. Previously, he was with Fluor Corp., Ltd., as vice president in charge of its four engineering divisions.

Vapor Recovery Systems Co. Completes Expansion . .

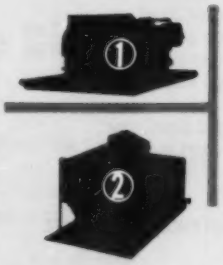
at Compton, Calif. The Electro-Mechanical department has been doubled in size and a complete new testing and development laboratory has been added. The engineering department has been enlarged to accommodate almost double its former capacity of engineers. General offices

Save money . . . control mud properties with BAROID CENTRIFUGE



Baroid's Mud Centrifuge spins out undesirable solids that may have adverse effects upon mud properties. Mud Centrifuge treatment aids in control of mud weight, viscosity, gel strength, filtration rate, and cake thickness.

Baroid's Mud Centrifuge rejects sand, contaminants, spent chemicals, and up to 50% of trouble-causing clays. This eliminates the jetting away of valuable mud and reduces the demand for chemical thinners. Baroid's Mud Centrifuge returns the useful mud weight to your mud tank for immediate re-use. Baroid is the *only* mud company to make a real attempt toward reducing mud costs by offering a really efficient centrifuge. On many jobs Baroid's Mud Centrifuge will pay its cost, with the weighting material conserved, in as little as two hours operation per day. Available on short or long term lease basis. For details call your local Baroid representative.



Simple and trouble-free, Baroid's Mud Centrifuge consists of (1) the skid mounted centrifuge, and a portable mud pump that is immersed in the mud pit, (2) a skid mounted engine (diesel, gasoline, natural gas, butane, or steam turbine) driving a hydraulic pump furnishing power to unit above. It requires no electrical equipment. Has built-in safety features preventing damage to equipment by loss of coolant or overloading.

BAROID

BAROID DIVISION • NATIONAL LEAD CO.
Main Office: P. O. Box 1675, Houston 1, Texas

BAROID DIVISION • NATIONAL LEAD CO.
P. O. Box 1675, Houston 1, Texas

Please send me your Centrifuge Bulletin.

Name _____ Title _____

Company _____

Address _____

City _____ Zone _____

B 5813

have been enlarged and new offices added for the sales, advertising, and accounting departments. Several new executive offices were also added.

Davis-Marler Co. Exclusive Dealer for Kimray, Inc. . .

in northern Louisiana, southern Arkansas, and East Texas. Davis-Marler, formed by W. L. Davis and W. R. Marler, maintains offices and warehouse stock in Shreveport, La.

Kimray is a manufacturer of oil and gas equipment and controls.

Baroid Division Appoints Epps, Tanner, Carnicom . .

R. K. EPPS

as sales development engineer in the general office, area engineer in the Texas Gulf Coast office, and area engineer, Louisiana Gulf Coast, respectively.

R. K. Epps was previously area engineer in the Gulf Coast area at Houston and has been with Baroid for 7 years. In his new duties, he will coordinate development, manufacture, distribution, and sale of drilling mud testing equipment.

K. D. TANNER

W. M. CARNICOM

K. D. Tanner, formerly area engineer for the Louisiana Gulf Coast area replaces Epps. He has been with the company for 6 years. W. M. Carnicom replaced Tanner. He has been with the company for 6 years.

H. T. Fielding, Jr., To Head New York Office . .

FIELDING, JR.

as eastern district manager for The Refinery Engineering Co. of Tulsa.

Fielding has 17 years experience as an engineer, sales representative, and sales executive with other firms. His latest position before joining Treco was industrial sales manager of Borg-Warner Corp.'s Pesco products division. He held the position from November 1955 until his resignation to join Treco. Previously, he was executive assistant to the vice president in charge of sales for M. W. Kellogg Co.

Drilco Oil Tools, Inc. Names R. D. Cloninger . .

CLONINGER

their representative in Lafayette, La., according to William S. Bachman, sales manager.

Cloninger worked as roughneck, roustabout, driller, and toolpusher from 1931 to 1948 in East Texas oil fields, Louisiana, and Mississippi. He set up his own business as a factory representative and continued this for 9 years. In August 1957, he became sales representative for Drilco in South Louisiana. The Drilco line includes rubber stabilizers, reamers, and drill collars.

WHEN YOU NEED
ACTION
A SERVICE PART —
COMPLETE OVERHAUL — or
TO REPLACE AN ENGINE
IN A HURRY — IT'S
ON THE WAY,
NOT ON ORDER!
Whether you need a repair job in a hurry or a quantity of engines for a new project, we are equipped to handle your needs quickly and efficiently.
We are the largest distributor of engines and parts in the Southwest.
WE HANDLE THE COMPLETE LINE OF WISCONSIN AIR-COOLED ENGINES and PARTS
"NOT ON ORDER . . . BUT ON THE WAY"
HARLEY
SALES COMPANY
WICHITA / TULSA / HOUSTON
WISCONSIN ENGINES AND SERVICE WIDELY AVAILABLE

Carnell Appointed By Ever-Tite Coupling Co., Inc. . .

as Midwest manager and sales engineer. He will make his headquarters in Cincinnati, Ohio.

V. J. Carnell has been supervisor, operations department, Pennsylvania division of Esso Standard Oil Co. in Philadelphia. This background and experience will enable him to provide oil and petrochemical companies with valuable assistance in application of quick couplings.

Martin-Decker Corp. Names D. A. Yeo, W. L. Fleming . .

western district manager and Midwest district manager, respectively. Alan G. Herrick, industrial sales manager, made the announcement.

Yeo, a 14 year Martin-Decker veteran, will be responsible for sales and distributor training throughout the 11 western states and western Canada.

Fleming will be responsible for sales and distributor training throughout the central and midwestern region of the United States, the province of Ontario, Canada.

K. L. Bourdo Co. Opens New Office In Tripoli . .

with Wesley Bourdo as manager. William E. Ridgeway has joined the oil field supply and service organization at the main office in Beirut, Lebanon. The company handles Ideco sales and service in the Middle and Near East and Northeast Africa. The offices in Tripoli were established to meet increasing demands of the growing oil industry in that area.

Prior to opening the offices in Tripoli, Bourdo was with Santa Fe Drilling Co. in California and Trinidad. He began oil-field career in 1935 as a roustabout in California.

WESLEY BOURDO

W. E. RIDGEWAY

Ridgeway has been senior drilling engineer for Kuwait Oil Co., an affiliate of Gulf Oil Corp., for the past 2 years. Prior to that he worked in Gulf's Tulsa drilling engineering division, and as drilling foreman in Montana and Wyoming.

W. A. Perkins Shifted . .

W. A. PERKINS

by Wilson Supply Co. from city sales at San Antonio, Tex., to city sales in Tulsa. In his new position he will assist P. S. Stover, Tulsa manager.

Wilson Supply's office is located at 601 Oil Capital Building.

Security International, C.A. Named Distributor . .

for all products manufactured by Security Engineering Division, Dallas, Tex.; and Security Rock Bits Ltd., Manchester, England. The announcement came from A. M. Birnie, executive vice president, sales.

Security International has established principal offices in Caracas,

announcing . . .

the all-new

D&S TRI-DIA Core Bit!

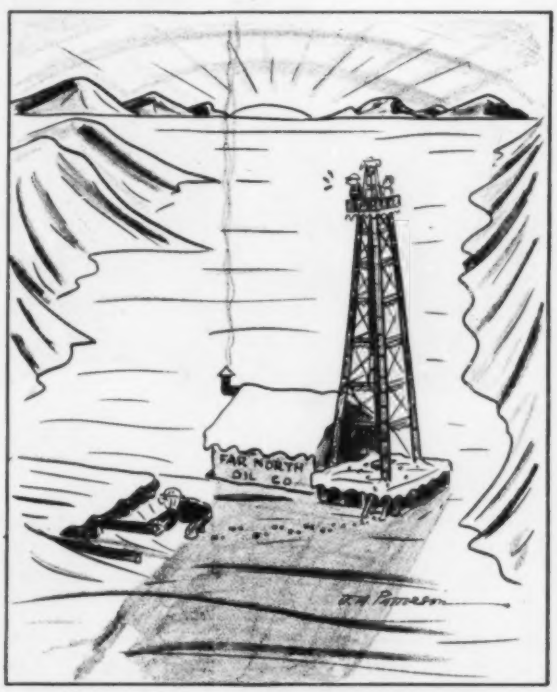
Check these outstanding features:

- Designed for safety.
- Reduced OD wall contact, similar to Tri-Cone Rock Bit.
- Reduces mud wall cake sticking hazard.
- When making trip, eliminates swabbing – hydraulic action.
- Minimizes junk iron hazard – allows washing out large pieces.
- Readily washes out cavings to bottom.
- Largest measurable diameter materially less than diameter of hole it will cut. (Special Bit Breaker required.)

WRITE OR CALL TODAY! One of the D & S sales engineers will call on you to show tremendous TRI-DIA Bit and Core Barrel advantages.

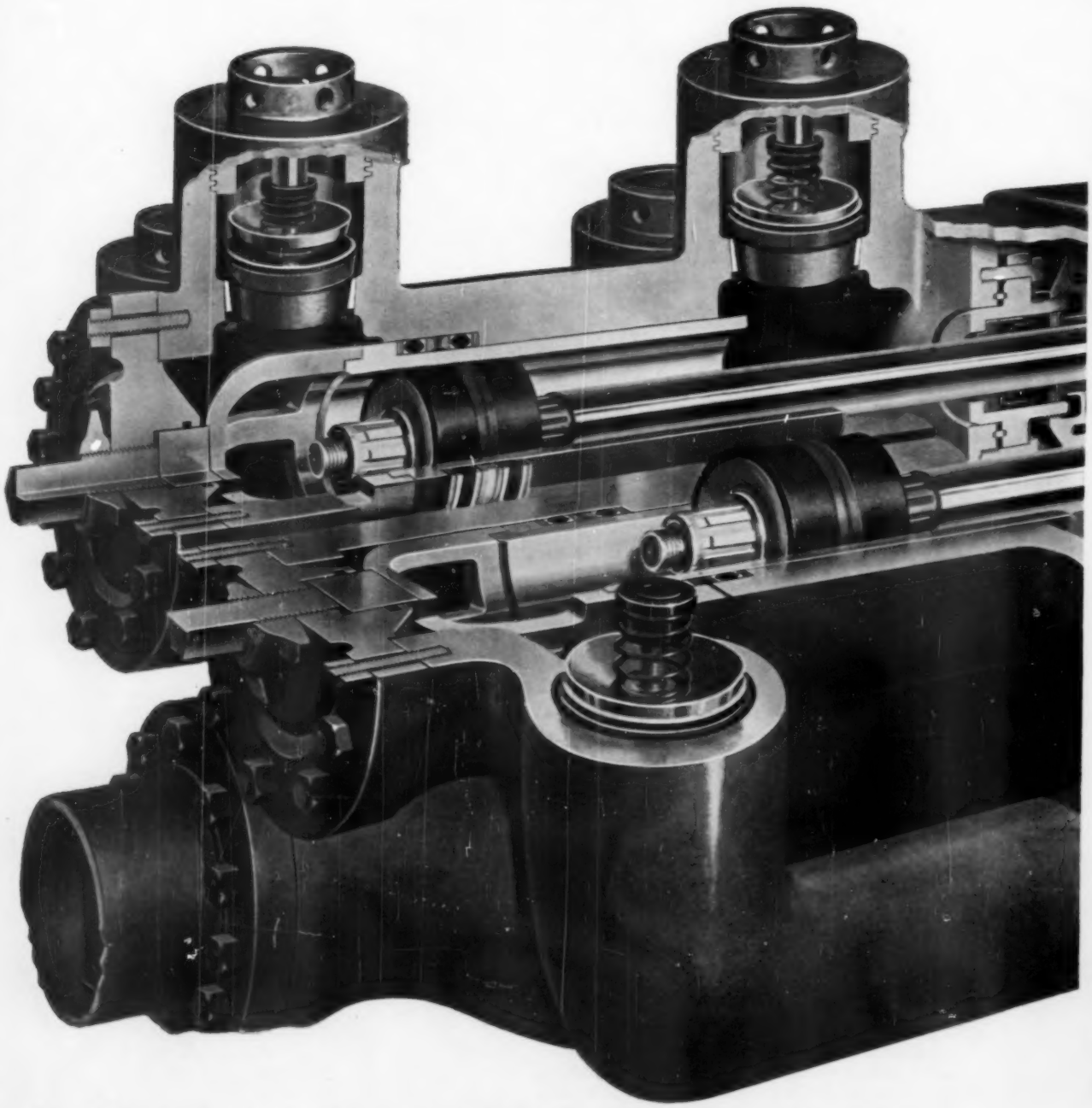
Drilling & Service INC. | DIAMOND DRILLING EQUIPMENT
6210 NORTH CENTRAL EXPRESSWAY | DALLAS, TEXAS
OFFICES IN ALL PRINCIPAL OIL AREAS

THE OIL AND GAS JOURNAL



"Man, howdy—that ole sun sho' feel good!"

The "Inside Story" of the Heart



Since fluid-end pump parts must be correctly maintained for longest service, Mission has prepared a special Pump Maintenance Manual for your benefit. Write for your copy today!

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In this service, only parts of advanced design and materials can stand up. That's why Mission has been a leader in pump parts research for many years.

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Ven., for sales and service in the Western Hemisphere and in London for the Eastern Hemisphere. South American manager is S. C. Welker. Eastern Venezuela district manager is A. R. Patton. Western Venezuela district manager is B. A. Barker. In London, sales manager is Harold Hall; assistant manager is Peter L. Winter.

Solar Aircraft Co. Names William F. Briney . .

as manager of industrial products sales, according to C. D. Oberg, director of sales. He will direct sales of industrial expansion joints, stainless steel cooling-tower fan blades, and other products.

W. F. BRINEY

Briney came to Solar from Le Roi division of Westinghouse Air Brake Co. At Le Roi he was manager of construction-industry sales, including stationary and portable air compressors, air tools, and specialized machinery.

J. A. Halpine & Son Named Distributor . .

of Electro-Span digital supervisory control systems in the Oklahoma, Kansas, and Missouri area, according to the manufacturer, Pacific Division of Bendix Aviation Corp.

J. A. and J. C. Halpine have offices in Tulsa.

John Feeser, Dan Talmo Join Houston Nomads . .

at its March 10th meeting. Feeser is with Brown Oil Tool Co., and Talmo is with Johnston Testers, Inc.

Plans for '58 Unveiled By Stewart & Stevenson . .

at its annual sales meeting. Engineering, manufacturing, distribution, and installation discussions ranged from Texan pump and stripper pump to power applications for trucks, irrigation, emergency generating equipment, and oil field.

Guests at the meeting, under the direction of Ross Stewart, chairman of the board, and Joe Manning, general manager of Stewart & Stevenson Services, Inc., included: D. D. Chene, Houston, regional manager for Chrysler Corp; and Eric Sutton, Dallas, district manager for Detroit Diesel Engines of General Motors.

Stewart & Stevenson personnel participating in the program included Tiny Herman, Bill Collett, Bob Mitchell, L. O. Carlson, and Harvey Trotter.

M. J. Crose Manufacturing Co. Builds Line-up Clamp . .

to handle 55-in. pipe. An average size man, inspecting this internal hydraulic line-up clamp, helps to show the dimensions of the clamp and its heavy construction. Crose designed and built it for special pipeline projects.

Babcock & Wilcox Co. To Build Boiler For Conoco . .

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Burgess-Manning's sales organization that attended the Fort Worth sales meeting.

Burgess-Manning Co. Holds Sales Meeting . .

of the industrial silencer division in Fort Worth, Tex., and it was attended by the company's district managers, sales representatives, and members of the sales, production, and research staff.

The market for the company's products and pulsation in gas pipeline systems were discussed and the deteriorating and costly effects of noise were pointed out by S. G. Paddock, executive vice president.

Engineering problems, along with new applications of industrial silencers, were analyzed and plans for the coming year were presented.

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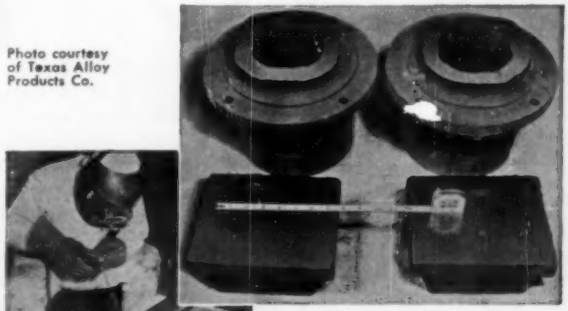
Photo courtesy of Texas Alloy Products Co.



Two 8 inch slides and throats after being reclaimed with Colmonoy No. 1 (shown finish ground)

A valve slide being hard-faced with Colmonoy No. 1 electrodes.

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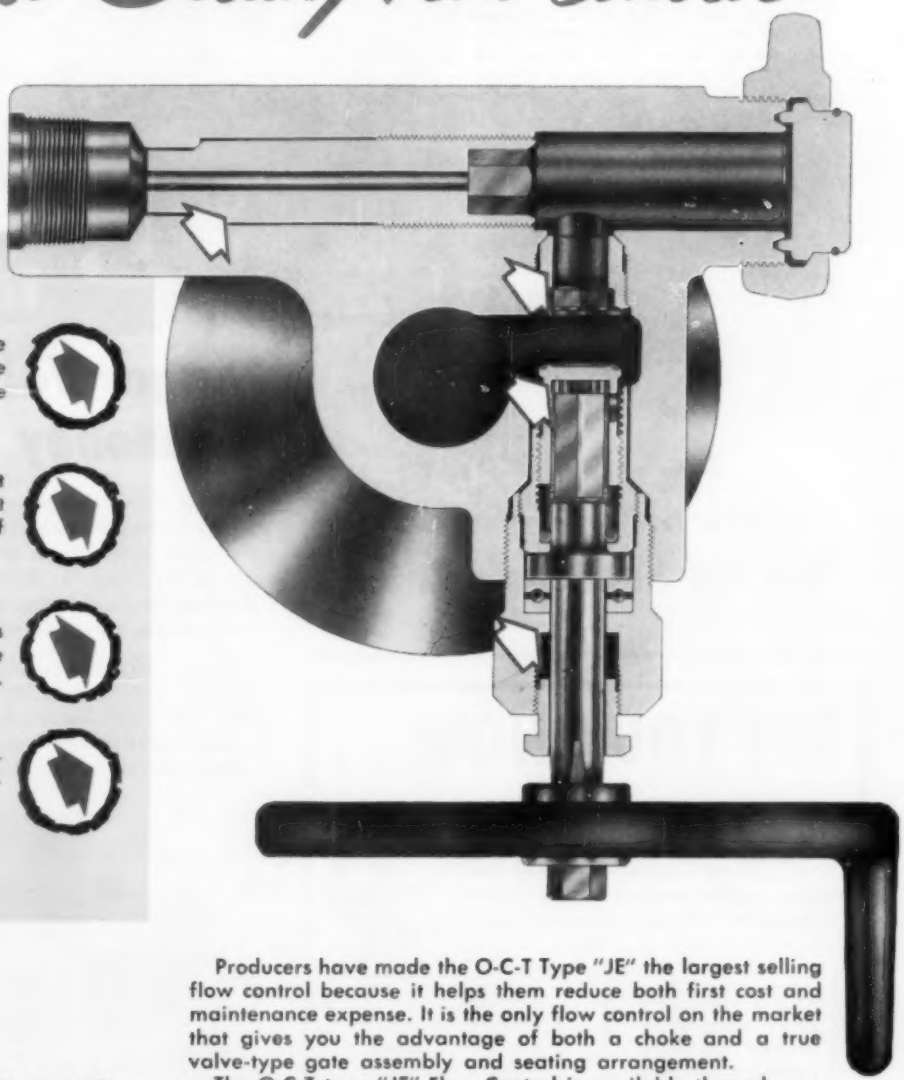

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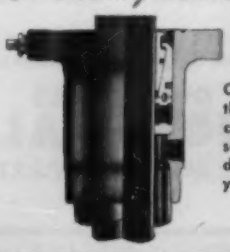

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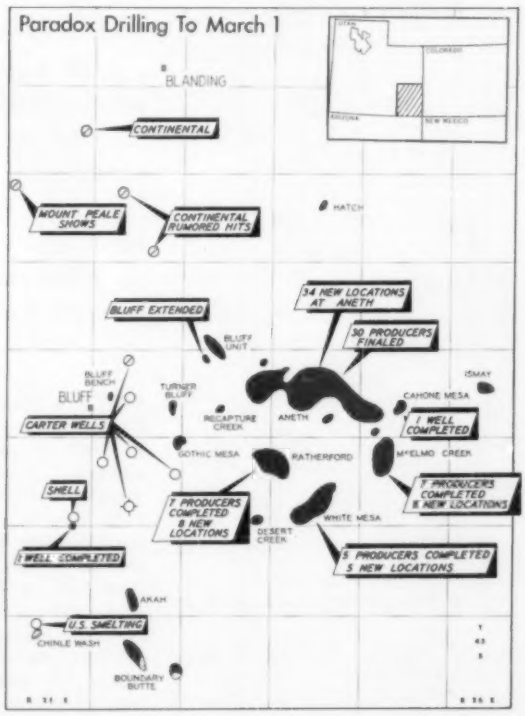
Paradox play to push northwest

. . . as wildcats play leapfrog in the next 2 years

BY FRANK J. GARDNER

IT'S REFRESHING to know, in these days of depressing news, that there are at least a few bright spots in oil. The brightest of them all is pictured here; southeastern Utah's Paradox basin campaign is the most successful in the United States today. And operators there are busily building up reserves for the coming of the Four Corners Pipeline Co.'s outlet to the West Coast.

So far this year, the Paradox story has been a development story, but pending tests and shows at remote wildcats will stimulate a fresh compaign among the explorers in the months to come. Don't be surprised if the "probably productive" area of the basin is doubled by the end of this year.



South eastern San Juan County, Utah, center of Paradox basin exploration, today has 91 new starts and active tests on the scout reports. Development drilling in anticipation of a major pipeline outlet has been extremely successful, with only 8 dry holes out of 73 completions so far in 1958.

Rumors and shows . . . Three first steps in this direction of expanded area have already been taken. These are three wildcats in the northwest corner of the map. In 38s-22e, Continental Oil Co. has two rumored hits, the 1 Federal-Miller in Section 8 and 1 Federal-Carter in Section 34. These two, if completed as producers, will certainly spark a new northward push in the basin. The third prospect lies in Section 6-38s-21e; it is Mount Peale Corp. 1 Mount Peale-Fehr, with reported oil and gas showings in cores of fractured limestone at the 2,700-ft. level.

A second cluster of wildcats lies in 40 and 41s-22e. All six of these are Carter Oil Co. efforts. One, the 42-1 Navajo (Section 28-41s-22e) has been abandoned at 6,336 ft.; the other five will feel out the gap between Bluff Bench, Tohonadla, and Gothic Mesa fields.

Development drilling, meanwhile, has been most rewarding. Of 73 field wells completed in the basin this year (through March 21), only 8 have failed. Aneth field, the largest of them all, has seen 31 new oilers finished and has 34 new ones staked or drilling. Other development progress is spotlighted on the map.

And a monster field . . . One stepout drilling program that may possess terrific impact is the one now going on between Aneth, White Mesa, McElmo Creek, and Ratherford fields, in 40 and 41s, 23 and 24e. Already, a link-up between Ratherford and White Mesa is taking shape as Phillips Petroleum Co. drills ahead on a quartet of tight explorers in Sections 15 and 16-41s-24e; one of these, the 2 Navajo A (Section 16) has been reported good for 1,620 bbl. per day, and it's a pretty good bet that the other three will pay. Other flank feelers are being drilled on the south side of Aneth, the east side of Ratherford, the north edge of White Mesa, and on every flank of McElmo Creek.

If by chance these four fields should merge, Paradox would have a monster field. Aneth itself is good for 200 million barrels, and it is conceivable that we are watching the growth of a half-billion-barrel field here.

Paint a bright picture . . . Today, scout reports list 91 starts and active tests in the area of the map shown here. In 2 years' time, the Paradox basin has emerged from near-oblivion to the brightest, most active spot in the nation.

On February 27, 1956, this column stated, not without some trepidation, that "... we are viewing the birth of a new producing province that will rank with any other in the country." Today, that province provides at least one cheerful aspect in an otherwise bleak exploration picture. And if another prediction is in order—try this for size—events in 38s-21 and 22e are the forerunners of a wildcat play that will push production north and west to the Colorado River within 2 years.

EXPLORATION

Cretaceous possibilities good for Northwest Kansas

Cretaceous rocks . . .

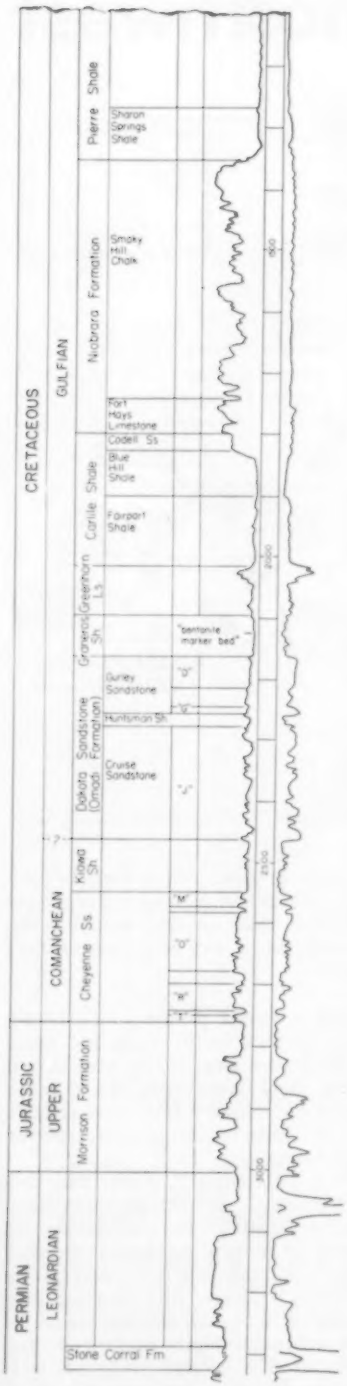
. . . as much as 3,000 ft. thick in northwestern Kansas are predominantly marine.

. . . contain good reservoir beds (Dakota and Cheyenne sandstones) with adequate cover.

. . . have favorable structure and stratigraphic variations for traps.

. . . are reported to have had numerous shows in northwestern Kansas.

BY DANIEL F. MERRIAM



ELECTRIC LOG of Ohio Oil Co. 1 Rose well (35-1s-40w, Cheyenne County) shows stratigraphic relation of beds of Mesozoic age in northwestern Kansas. Fig. 1.

SINCE a major discovery of oil in Cretaceous beds in the Denver basin in 1949, intensive efforts to locate additional producing areas in southwestern Nebraska and eastern Colorado have been successful. Although northwestern Kansas may be considered a part of the Denver basin petroleum province, little attention has been given Cretaceous rocks in the state. At present, easternmost discoveries in the Denver basin are only about 50 miles from the Kansas border; major oil and gas fields are as near as 80 miles from the state line[5]. On the basis of these developments, it seems logical that petroleum reserves may be found in similar rocks in Kansas.

Although many wells have reported uphole shows of oil or gas, the only production recorded in Kansas from beds of Cretaceous age was gas from Goodland field (discovered in 1939) in Sherman County. Gas was produced for a short time from the basal part of the Pierre shale and upper part of the Niobrara formation at a depth of about 1,100 ft. Gas was reported also in the Niobrara formation in Wray field just across the Kansas line in Yuma County, Colorado. The Anderson 1 Tilma well (11-85-3w) in Sheridan County reported a gas show from the Codell sandstone(?) before the hole was lost at a depth of 1,008 ft.

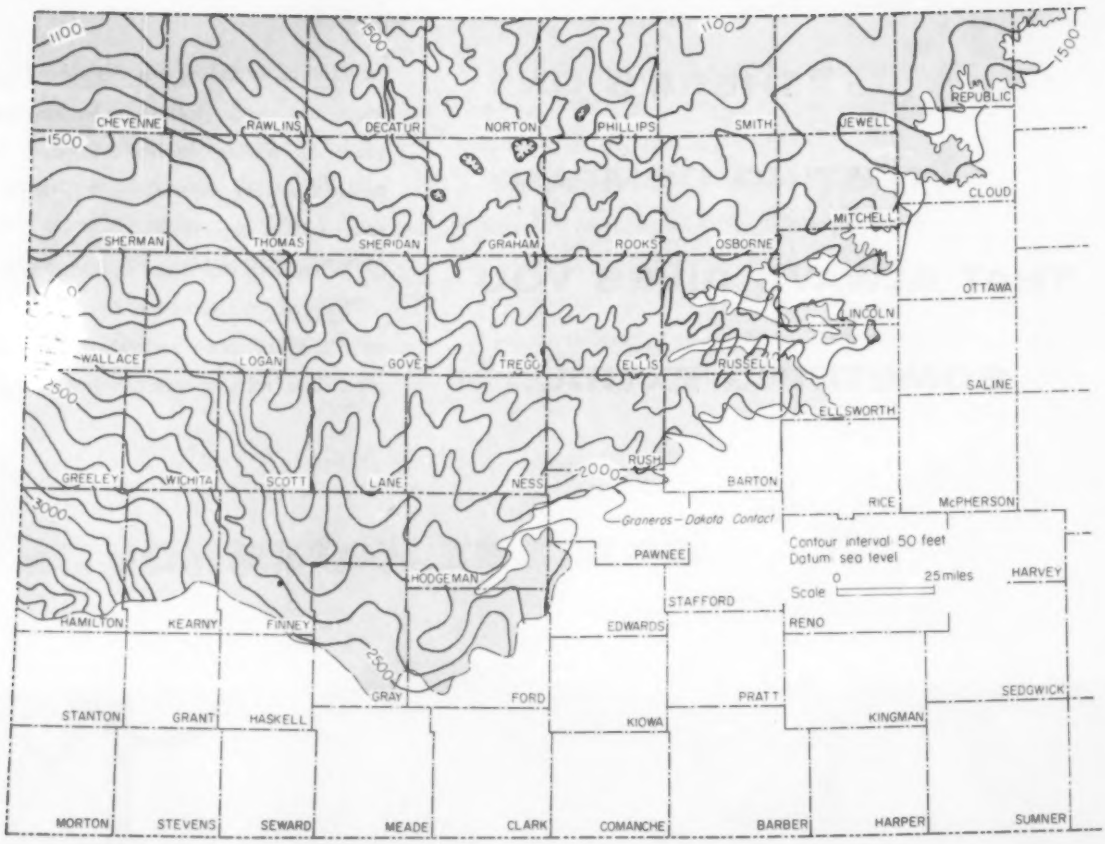
The Keys 1 Paxson (23-8s-24w) in Graham County reported a show of oil in the Dakota. Some oil saturation was encountered in a core of the Dakota taken in the Atkinson 1 Beaumeister (31-2s-39w) in Cheyenne County. To the present, however, the amount of petroleum found in rocks of Cretaceous age in Kansas has been disappointing.

Author is geologist with the State Geological Survey of Kansas. Publication of this article authorized by the director of the State Geological Survey of Kansas.

Conditions suitable for petroleum accumulation . . . The Dakota and Cheyenne sandstones are the only Mesozoic beds in northwestern Kansas that are known to have the properties generally regarded as essential for ultimate accumulation of petroleum. Although both the Dakota and Cheyenne have some possibilities, only the Dakota is discussed here.

In extreme northwestern Kansas, the Cretaceous may be as much as 3,000 ft. thick. Stratigraphic position of the Dakota sandstone in this sequence is shown by an electric log of the Ohio 1 Rose (35-1s-40w) in Cheyenne County (Fig. 1). The entire Cretaceous section overlying the Dakota is presumably marine, as is the underlying Kiowa shale. Recent investigation[3] shows that at least part of the Dakota is marine. This is in contrast to the outcrop farther east, where the formation is believed to be nonmarine[4].

A study of a core from the Atkinson 1 Beaumeister showed porosities ranging to 33 per cent and permeabilities to 2,300 md. in the Dakota sandstones. These porosities and permeabilities are similar to those in producing areas of the Denver basin. These sands, then, should provide necessary



REGIONAL STRUCTURAL CONTOUR MAP on top of Dakota sandstone (Cretaceous), Central and West Kansas reveals numerous positive trends. Eastern and southern margin of map is limited by the Dakota-Graneros contact. Fig. 2.

reservoir space; the clayey Graneros shale certainly provides a cover for the formation.

Most individual sand beds in the Dakota are discontinuous and lenticular, therefore difficult to correlate; however, it is possible to trace major shale sections. The ratio of sand to shale decreases eastward towards the outcrop, where the formation includes about 75 per cent clay and clayey shale. A structure map on top of the Dakota (Fig. 2) reveals closure in southeastern Decatur and southwestern Norton counties in the vicinity of the Cambridge arch, and in southeastern Ellis County. A smaller contour interval would show correspondingly smaller structures.

Many northerly plunging structural noses are evident on the eastern flank of the Las Animas arch and in the western Kansas basin. Updip wedgeouts of sand, or porosity and permeability pinchouts on any of these noses would produce a suitable trap. Updip pinchouts of permeability of the Dakota sands ("D" and "J") on structural noses provide numerous traps in the Denver basin, for example Adena, Badger Creek, Bonham, Masters, Grayline, Little Beaver, Luft, Middlemist, and Willard fields.[5]

Occurrence of petroleum in Dakota beds only 50 miles west of Kansas in the Denver basin and reported shows from these beds in Kansas, and occurrence of gas in the Codell sandstone(?), Niobrara formation, and Pierre shale presumably indicate the presence of source beds.

Dakota water mineralized and artesian . . . Generally water in ithe Dakota is under artesian pressure and at numerous places in the state it flows to the surface. Over large areas, water in the Dakota is strongly mineralized, especially in Russell and Ellis counties[1]. Analyses indicate that the water is similar to oil-field waters in the Dakota "D" and "J" sands of the Denver basin. Nevertheless at places in Kansas, Dakota water is potable.

Subnormal pressure in the Dakota . . . Drill-stem tests of Dakota rocks in several wells in northwestern Kansas found subnormal pressures. A test of the upper part of the Dakota in the Brack 2 Judy (35-1s-39w, Cheyenne County) between 2,001-74 ft. open ½ hour recovered 900 ft. of fresh water; bottom-hole pressure was 440 psi.

A test between 2,081-90 ft. in the Dakota for ½ hour had a strong blow and recovered 290 ft. of fresh water. Another well in Cheyenne County, The Texas Co. 1 Walz (3-5s-42w), tested the lower Graneros and upper Dakota between 2,188-2,200 ft. for 1 hour and recovered 30 ft. of watery drill mud; bottom-hole pressure was 415 psi.

In Sherman County the Shell 1 Harden (24-6s-40w) tested the Dakota between 2,213-33 ft. for ¾ hour and recovered 60 ft. of muddy water; bottom-hole pressure was 360 psi.

Another test in the Dakota between 2,262-2,313 ft. for 40 minutes recovered 1,050 ft. of muddy salt water; bottom-hole pressure was 450 psi. The Continental (11-5s-27w) 1 Koeperich in Decatur County tested Dakota between 1,110-88 ft. for 1 hour and recovered 455 ft. of muddy water; bottom-hole pressure was 210 psi. Continental also tested the Cheyenne sandstone between the depths of 1,465 and 1,525 ft. for ½ hour recovering 770 ft. of muddy water; bottom-hole pressure was 325 psi.

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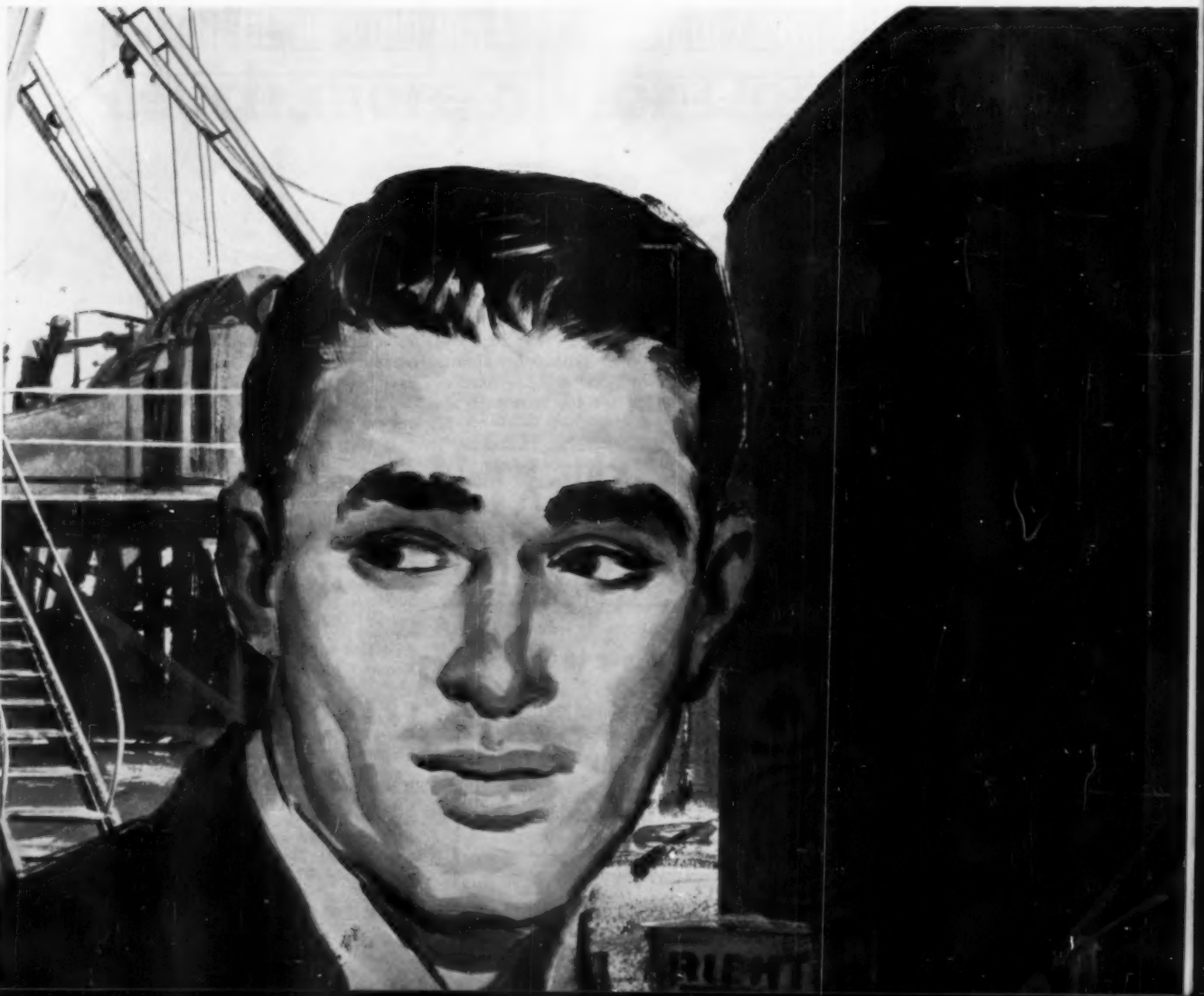
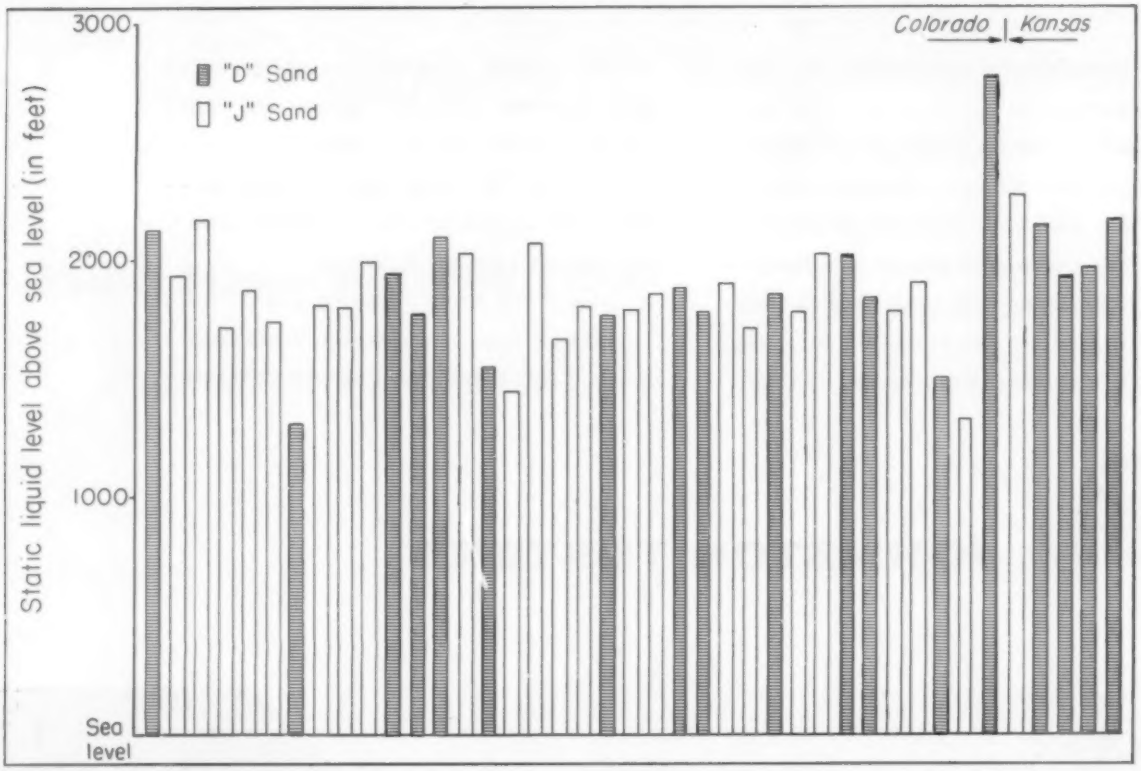




STATIC LIQUID LEVEL in wells in Denver basin are compared to wells in northwestern Kansas. Static level in Denver basin fields is based on initial field pressures; level in Kansas is based on bottom-hole pressures obtained in drill-stem tests. Fig. 3.

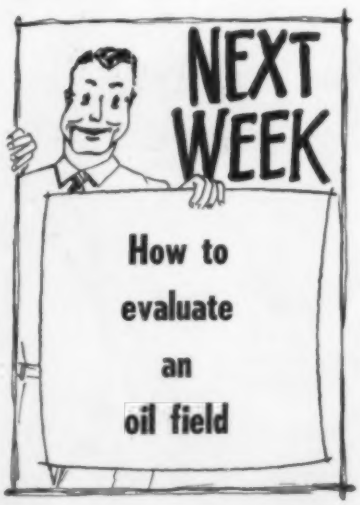
mation was being sealed off either by swelling of the formational clays or penetration of the drilling mud into the formation. In the Atkinson 1 Beaumeister, a study of Dakota clays revealed mostly illite and kaolinite, which are nonswelling clays.

Initial pressures of the Denver basin fields are subnormal (Fig. 3). Subnormal bottom-hole pressures such as were encountered in drill-stem tests of the Dakota in Kansas are therefore to be expected. Subnormal pressures are characteristics of the Dakota; the reason is not known, but such pressures should not be detrimental to petroleum accumulation.

Why not Dakota oil in Kansas? . . . Although Dakota beds occupy a geological setting similar to beds of the same age that produce commercial quantities of petroleum farther west in Colorado, there is no assurance that commercial quantities of petroleum are present in the Cretaceous rocks of Kansas. Why? From the previous discussion it seems obvious that all the conditions necessary for petroleum accumulation in Dakota beds are fulfilled.

Several explanations may be offered at this time for the apparent absence of oil in Cretaceous reservoirs in the state: (1) Petroleum in commercial quantities may be present but as yet undiscovered. Cretaceous rocks in Kansas are usually regarded as something of a nuisance to drilling, and little attention has been paid to them. In six northwestern Kansas counties (Cheyenne, Logan, Rawlins, Sherman, Thomas, and Wallace), an area of more than 6,100 sq. miles, only about 130 wells have been drilled—hardly an adequate test for the area even if the Dakota had been the objective. (2) Conditions necessary for the origin or accumulation of petroleum may never have been fulfilled in Kansas despite all evidence to the contrary. It is possible that if the oil migrated from the deeper parts of the Denver basin, it was trapped on the western flank of the Las Animas arch before reaching the state. (3) Petroleum may have been present, but possibly flushed by active water movement; consequently the beds are now barren.

It is hoped that Kansas operators will scrutinize the Dakota more closely in the future.



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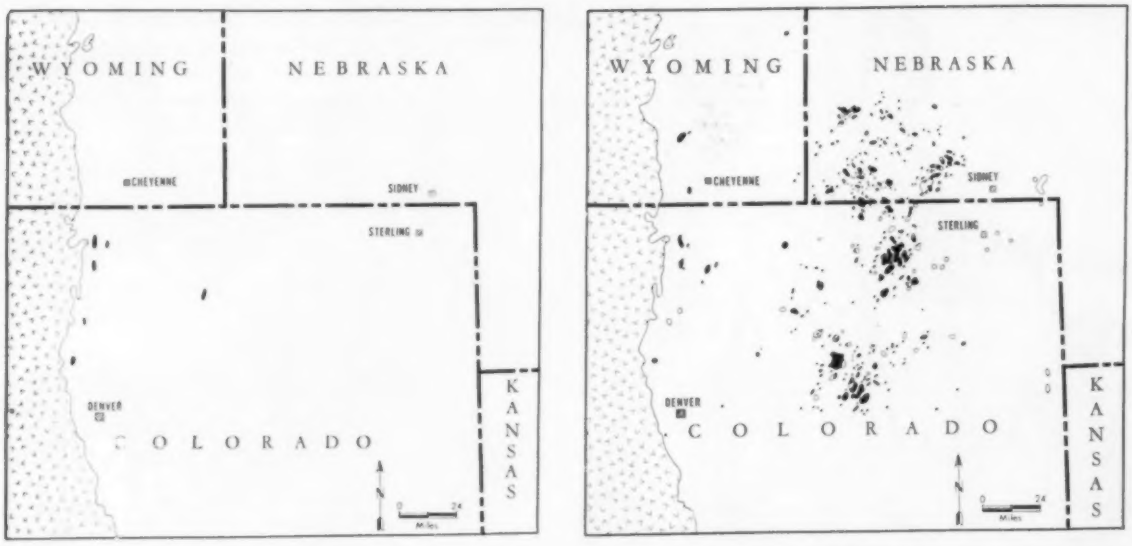

This geologist predicts . . .

Much more oil for Denver basin

BY REX MONAHAN
Geologist, Sterling, Colo.

THE FUTURE of the Denver basin depends upon the imagination and aggressiveness of its operators.

More attention needs to be given to the several potential producing horizons that lie above the Dakota-Cretaceous "D" sand and those below the "J." Additional study must be done in an effort to more accurately predict the presence of traps in the "D" and "J" sands. With the increased amount of well control now available, the task is somewhat simpler than in earlier years.

Very few areas in the United States have ever been subjected to the drilling impact which this basin has undergone in the past 9 years. However, it can hardly be said that the area has been thoroughly prospected, for the drilling density is but one test per 6 sq. miles. This density figure is misleading in itself, as most of the drilling has been done in a relatively small area.

Several secondary-recovery projects have been started in the basin, and early results indicate that much additional oil can be recovered, particularly in the larger fields.

A new era ahead . . . A continuance of the current activity can be expected, due to the relatively cheap drilling costs, adequate pipeline facilities, high-gravity noncorrosive crude oil, and sufficient reserves. A further stimulus should be provided by the millions of acres of oil and gas leases which expire in 1959 and 1960. The advent of these expiration dates should cause more farmouts to be made and on more favorable terms. The actual expiration of some of the untested acreage will bring about a new and more diversified lease ownership. This will make possible the promotion of more exploratory activity which at present is somewhat restricted due to the extensive individually controlled acreage.

As an indication of the future oil-finding possibilities in the basin it is instructive to note that during the first 3 weeks of 1958 there were nine new oil discoveries scattered from the Nebraska Panhandle to deep in the Colorado portion of the area.

How It Grew

For almost 9 years the Denver basin has been the scene of intensive drilling activity; this has resulted in the discovery of some 376 oil fields. In this short time, the basin has become a major producing province.

Known variously as the Denver basin, Julesburg basin, and Denver-Julesburg basin, the province has recently been officially designated by the Rocky Mountain Association of Geologists as the Denver basin. It is one of the largest sedimentary basins in the United States and embraces the eastern portion of Colorado, southeastern Wyoming, western Nebraska, and northwestern Kansas. Its greatest north-south dimension is 290 miles and its east-west dimension is 200 miles.

The basin's principal producing horizons are the "D" and "J" sands of the Dakota series (Lower Cretaceous). Oil has also been found in the Lyons sand (Permian), "M" sand (Lower Cretaceous), Hygiene sand (Upper Cretaceous), Greenhorn limestone (Upper Cretaceous), and the Fort Hayes limestone (Upper Cretaceous). The depth of the producing wells ranges from 3,300 ft. ("D" and "J" sands) on the east flank of the basin to 9,000 ft. (Lyons sand) on the west flank. The average "D" and "J" sand well produces at a depth of about 5,500 ft. The oil produced from the "D" and "J" sands is sweet and its gravity averages 39° API.

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THE AUTHOR

The author is a geologist and independent oil producer at Sterling, Colo. He began his Denver basin activities in 1950 after receiving B.A. and B.S. degrees from the University of Nebraska. From 1943 through 1946 he served in the U. S. Army as an infantry officer.

Early search . . . Its beginning as an oil-producing area dates back to 1862 when A. M. Cassedy drilled the discovery well at Florence, Colo., just 3 years after Colonel Drake's well at Titusville, Pa. Sporadic drilling resulted in small discoveries near Boulder in 1902 and Fort Collins in 1923. Greasewood field in Weld County, Colorado, was discovered in 1930, but did little to further the development of the basin.

And the recent search . . . In 1949 Ohio Oil Co. drilled a seismic prospect in Cheyenne County, Nebraska, and discovered Gurley field, with production from the "D" sand. This discovery touched off the current play and in the past 9 years, some 9,255 tests have been drilled and 376 oil fields discovered; 186 in Colorado, 185 in Nebraska, and 5 in Wyoming. Of the 9,255 tests drilled, 3,174 were oil wells, 221 were gas wells, and 5,860 were dry holes. That's an overall success ratio of 36.6%.

The Basic Facts

Stratigraphic traps account for at least 85 per cent of all the fields in the basin. These traps largely consist of shoestring sands, sandstone lenses, and updip permeability pinchouts of more or less continuous sandstone bodies. The early seismic work of Ohio Oil in central Cheyenne County, Nebraska, defined many mildly folded structures, most of which produced oil or gas. These structures produced independently of stratigraphic considerations and no doubt greatly influenced the industry's exploratory thinking. It has since been found, however, that the stratigraphic type trap is the principal controlling factor in oil and gas accumulation in the basin.

Costs . . . Drilling costs provide one of the basin's greatest attractions. At present, a "J" sand test can be drilled to 5,500 ft. for $18,000, turn key. This figure includes location preparation and restoration, surface casing, shoe and cement, two cores (total 70

Why Blowouts Are Getting Few And Far Between

Pipe bent like spaghetti . . . rigs reduced to scrap . . . and a fortune up in smoke is still clear in the minds of many oil operators.

In the middle 1930's, spectacular blowouts and costly fires were almost commonplace. Practically every new field, where deeper exploration was in progress, was pock-marked with a crater or two, grim reminders for the rigs that followed of the hazards that lay ahead for them.

The recognized discovery of "drilling mud" came with Spindletop where cows were driven through the earthen tanks to mix mud. Surface controls, such as blowout preventers, gained prominence after the famous "Wild Mary" Sudik in Oklahoma City.

Steady improvements in controlled drilling fluids and surface control equipment signalled the start of a new era in deeper drilling and completion practices. Throughout all the development stages of better well control, oil operators and PESA Members have worked as a team.

Still, there is much to be done.

And much of it will be accomplished in the future, as in the past, through the research facilities, time, money and personnel of members of the Petroleum Equipment Suppliers' Association.

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ft.), two drill-stem tests, core analysis, electric log, MicroLog, laterolog, and geologist. This is in sharp contrast to 1951 costs of approximately $27,000 for the same job.

Completion costs on a well of this depth including casing, tubing, rods, pump unit, motor, treater, and tanks would be an additional $37,000.

Outlet adequate . . . Pipeline outlets are more than adequate. Present production averages 119,000 bbl. of oil per day and the combined total which the Platte, Service, and Arapahoe pipelines can handle from the basin is in the vicinity of 195,000 bbl. per day.

Gas looms large . . . Gas production in the basin is derived from 148 straight gas wells; 88 in the Colorado portion and 60 in the Nebraska portion. Of greater importance, however, is the casing-head gas from its 2,437 producing oil wells. For example, the largest proved gas reserve is located in Adena oil field in Morgan County, Colorado, which produces 23,500 M.c.f.d. At present there are 16 gas-products plants which are processing approximately 90 M.M.c.f.d. Total production is 148 M.M.c.f.d., but some of the gas is being employed in repressuring operations. Cumulative gas production from 1949 through 1957 was 4,646,812 M.c.f. The interstate gas-transmission companies in the area are Colorado Interstate Gas Co., Kansas-Nebraska Natural Gas Co., and North Central Gas Co.

Oil sands attractive . . . Oil production in the basin is not necessarily a feast-or-famine proposition. The isolated sand lens and shoe-string sand reservoirs have a solution-gas drive with a combination solution-gas and water drive in some cases. The structural reservoirs are generally a combination of water and solution-gas drive. Recoveries range from 100 to 600 bbl. per acre-foot. Net pay thickness ranges from 4 to as much as 60 ft., with 10-15 ft. being the average.

Reserves Are Favorable

As of December 1957, some 3,174 oil wells had been completed and 205,146,374 bbl. of oil produced from the Denver basin. This makes an average of 64,630 bbl. of oil per well. Daily average oil production was 119,000 bbl. from the 2,437 wells which are currently producing.

Estimated proved crude-oil reserves were 253,302,000 bbl. on primary recovery (129,302,000 from the Colorado portion and 124,000,000 from the Nebraska portion).

Combining the cumulative production and the estimated proved reserves, the average ultimate cumulative production for all oil wells completed would be 144,000 bbl. per well. In addition, an average of 1 M.c.f. of casing-head gas is produced with each barrel of oil, which results in a substantial increase in the value of the well.

Although a complete profitability analysis of all operations by all operators is far beyond the scope of this report, it would appear that the basin's reserves are adequate; i.e., commensurate with drilling and development costs.

Some operators have complained of a lack of reserves in the basin without ever examining the cumulative production of the wells already drilled. The following tabulated figures might possibly throw a bit of light on the subject:

No. of prod. oil wells as of Dec. 1957	Average cumulative production per well (bbl.)
17	300,000-600,000
10	275,000-300,000
10	250,000-275,000
14	225,000-250,000
31	200,000-225,000
36	175,000-200,000
110	150,000-175,000
122	125,000-150,000
209	100,000-125,000
249	75,000-100,000
480	50,000- 75,000
606	25,000- 50,000
543	0- 25,000
2,437	

It must be remembered that of the 543 wells in the 0-25,000-bbl. category, some 400 were completed in the year 1957. As a result they have not had sufficient producing time to reach any of the categories. On the dismal side, however, it must be pointed out that as of December 1957, there were 117 shut-in oil wells that had made less than 25,000 bbl. and will probably never pay out. For most operators, a payout is reached at 22,000-25,000 bbl. after salvage.

The production figures tabulated above compare favorably with other major producing provinces such as the Illinois basin, Central Kansas, and the eastern portion of the Powder River basin in Wyoming.

Most of the fields are not particularly large, but one notable exception is Adena field in Morgan County, Colorado, with 114 producing wells and daily production of 13,500 bbl. Another is Sloss field in Kimball County, Nebraska, with 81 producing wells and daily production of 6,500 bbl.

Who's There?

There are more than 100 major companies and independent operators with production in the Denver basin. The largest producers are as follows:

Operator—	Avg. daily production Dec. 1957
British-American Oil Producing Co.	12,176
California Co.	4,479
Champlin Oil & Refining Co.	3,518
Continental Oil Co.	5,855
Monsanto Chemical Co.	5,700
Magnolia Petroleum Co.	1,830
Ohio Oil Co.	7,100
Pan American Petroleum Co.	14,839
Pure Oil Co.	6,474
Shell Oil o.	7,701
Sinclair Oil & Gas Co.	2,600
Skelly Oil Co.	3,711
Superior Oil Co.	1,419

The balance of the production is owned by other major companies and independents, a number of which are in the 500-1,000-bbl. per day class.

Acknowledgment

Information was derived from the following sources: Petroleum Information, British-American Oil Producing Co., Denver basin oil scouts, Kansas-Nebraska Natural Gas Co., Ohio Oil Co., Skelly Oil Co., Colorado Oil and Gas Conservation Commission, and Nebraska State Geological Survey.

Williston's Burke flourishes

NORTH DAKOTA'S important Burke County area picked up two new discoveries, one northeast of Flaxton field, the other south of the Lignite area.

Pan American Petroleum Corp. recovered oil on drill-stem tests of both the Midale and Nesson-Mississippian at the 1 Owings, C SE SW 13-161n-92w, about 8 miles south of the Lignite field area.

McAlester Fuel Corp. et al found oil on drill-stem test of the 1 Nelson in C SE SW 22-163n-90w, 1½ miles northeast of Flaxton field. The shows were in the Mississippian zone.

Southwest Michigan gas play looms

TWO SALINA deep tests in the "work over" Allegan County district showed gas in objective horizons to raise prospects for extensive development and exploratory work in Southwest Michigan this year.

Ford Oil Co. 1 Gruncinski SE NW NE 4-3n-12w, in the old Hilliards 1,600 ft. Traverse oil pool, drilled estimated 900 M.c.f. of gas in the A-1 Salina dolomite from 2,939-66½

How February field and wildcat drilling compared in footage

	FIELD WELLS					WILDCAT WELLS			
	Oil	Cond.	Gas	Dry	Service	Oil	Cond.	Gas	Dry
Alabama	45,910	.....	.....	.....	.....	.....	.....	.....	13,977
Arizona	.....	.....	.....	.....	.....	.....	.....	.....	7,464
Arkansas	71,315	.....	.....	32,935	.....	7,182	.....	8,974	29,758
California	432,116	.....	6,650	102,450	.....	3,729	.....	.....	106,487
Colorado	56,609	.....	15,322	66,859	.....	15,139	.....	10,543	179,393
Illinois	164,157	.....	1,463	120,335	.....	.....	.....	.....	41,627
Indiana	35,657	.....	1,764	26,508	.....	990	.....	2,987	12,513
Kansas	436,505	.....	24,928	259,620	26,790	19,763	.....	10,517	160,524
Kentucky	15,036	.....	18,108	19,305	.....	1,786	.....	.....	3,379
Louisiana	747,528	243,087	75,559	541,898	.....	30,369	13,500	19,543	164,862
North	112,085	.....	24,782	89,618	.....	.....	.....	19,543	13,683
South	383,488	229,911	50,777	401,449	.....	30,369	13,500	.....	151,179
Offshore	251,955	13,176	.....	50,831	.....	.....	.....	.....	.....
Michigan	29,853	.....	.....	11,929	.....	.....	.....	.....	21,901
Mississippi	14,020	27,708	.....	39,208	.....	30,580	.....	.....	96,040
Montana	61,001	.....	.....	17,248	.....	12,948	.....	.....	57,635
Nebraska	65,007	.....	.....	105,680	.....	34,877	.....	.....	84,676
New Mexico	427,845	21,386	120,091	54,959	.....	34,299	16,600	.....	87,372
West	162,815	.....	120,091	7,267	.....	8,180	.....	.....	65,711
East	265,030	21,386	.....	47,692	.....	26,119	16,600	.....	21,661
New York	27,050	.....	.....	.....	27,050	.....	.....	.....	.....
North Dakota	126,291	.....	.....	32,097	.....	9,229	.....	.....	52,506
Ohio	100,991	.....	59,493	33,743	11,945	.....	.....	.....	.....
Oklahoma	749,642	136,929	106,315	396,427	41,412	60,227	16,340	34,206	173,286
Pennsylvania	.....	.....	95,685	2,377	.....	.....	.....	.....	5,690
Tennessee	485	.....	.....	.....	.....	.....	.....	.....	995
Texas	3,001,882	249,078	345,686	844,214	34,647	126,384	23,828	25,100	1,053,991
Dist. 1	37,457	.....	29,191	44,621	396	5,844	.....	.....	69,455
Dist. 2	47,885	25,105	22,867	66,010	.....	.....	.....	14,113	36,608
Dist. 3	271,932	44,227	13,367	132,974	.....	14,005	.....	.....	92,800
Dist. 4	68,529	45,083	13,937	115,289	.....	6,000	7,825	.....	110,341
East	229,355	32,961	.....	63,164	.....	.....	.....	.....	123,265
Dist. 7-B	196,362	5,373	8,130	118,399	4,300	25,085	4,558	.....	168,681
West	1,623,997	47,022	30,268	104,956	7,695	45,694	2,810	.....	258,099
Dist. 9	350,047	.....	85,184	165,554	22,256	12,888	.....	10,987	149,750
Dist. 10	176,318	49,307	142,742	33,247	.....	16,868	8,635	.....	44,992
Utah	162,597	.....	3,781	17,352	.....	.....	.....	.....	29,006
Washington	.....	.....	.....	.....	.....	.....	.....	.....	10,157
West Virginia	24,187	.....	134,787	23,160	.....	.....	.....	8,693	11,773
Wyoming	144,116	.....	9,025	39,844	.....	5,777	.....	17,610	63,749
Total United States	6,939,800	678,188	1,018,657	2,788,148	141,844	393,279	70,268	138,173	2,468,761
Western Canada	537,670	.....	26,933	35,584	.....	44,544	.....	33,954	316,945
Alberta	328,561	.....	26,933	12,663	.....	33,700	.....	20,195	245,35,
Saskatchewan	179,156	.....	.....	16,478	.....	10,844	.....	.....	39,274
Manitoba	26,189	.....	.....	2,153	.....	.....	.....	.....	1,775
British Columbia	3,764	.....	.....	4,290	.....	.....	.....	13,759	30,539

ft., tentative completion point. Exploratory test is located 3 miles southeast of the Dorr-Salem field, where A-2 Salina is being developed for both oil and gas.

Current exploration in Allegan County is confined generally to the same areas or on flanks that produced 1,600-ft.-deep Traverse oil pools in the 1936-45 drilling campaign.

New Mexico Well Data Book Published

SUBSURFACE Completion Data of Wells Drilled for Oil and Gas During 1956, Circular 49, is a new publication by New Mexico Bureau of Mines and Mineral Resources.

It is one of a series compiled by the bureau on completion and production statistics.

Circular 49 lists all wells drilled during the year 1956, by county; divided into wildcats and field wells. Listing is alphabetically by companies. Data include company name and lease, well unit, location, completion date, initial production, elevation, total depth, top of pay; whether shot or acidized, the amount of acid or fracture treatment, interval shot or acidized, and the size and depth of oil string casing.

The book is well done with an attractive paperback cover. Write New Mexico Bureau of Mines and Mineral Resources, New Mexico Institute of Mining and Technology, Socorro.

New Gas Pool Confirmed in Ohio

Confirmation of a gas pool in Pleasant Township, Perry County, 4 miles southeast of New Lexington, was reported by the operators, Witherspoon & McGee.

Their first test on 1 C. Hillis, Section 24, gaged 2,740 M.c.f. gas with 50 bbl. oil in 24 hours after fracture from Clinton at 3,572-3,637 ft.

Their first offset, the 1 H. Storts, Section 24, gaged 3 M.M.c.f.d. after fracture from sand at 3,568-3,621 ft. and their third test is now under way.

The total count of the nation's February completions, by state

	TOTAL COMPLETIONS							WILDCAT WELLS							
	Total	Crude	Cond.	Gas	Dry	Service	Footage	Total	Crude	Cond.	Gas	Dry	Footage	C.T.	Act. op.
Alabama	6	4	0	0	2	0	59,887	2	0	0	0	2	13,977	0	16
Arizona	4	0	0	0	4	0	7,464	4	0	0	0	4	7,464	0	3
Arkansas	45	27	0	1	17	0	150,164	10	2	0	1	7	45,914	0	67
California	152	104	0	1	47	0	651,432	27	1	0	0	26	110,216	2	211
Colorado	68	13	0	5	50	0	343,865	41	3	0	2	36	205,075	0	88
Illinois	144	72	0	4	68	0	327,582	20	0	0	0	20	41,627	14	370
Indiana	52	19	0	4	29	0	80,419	15	1	0	2	12	16,490	41	81
Kansas	266	132	0	9	115	10	938,647	49	5	0	2	42	190,804	8	372
Kentucky	43	16	0	7	20	0	57,614	5	1	0	0	4	5,165	31	131
Louisiana	210	103	20	13	74	0	1,836,346	23	3	1	2	17	228,274	0	401
North	65	33	0	9	23	0	259,711	5	0	0	2	3	33,226	0	134
South	112	43	19	4	46	0	1,260,673	18	3	1	0	14	195,048	0	215
Offshore	33	27	1	0	5	0	315,962	0	0	0	0	0	0	0	52
Michigan	23	10	0	0	13	0	63,683	9	0	0	0	9	21,901	17	106
Mississippi	24	5	3	0	16	0	207,556	15	3	0	0	12	126,620	0	47
Montana	32	16	0	0	16	0	148,832	15	4	0	0	11	70,583	3	55
Nebraska	50	17	0	0	33	0	290,240	22	6	0	0	16	119,553	0	35
New Mexico	154	91	3	28	32	0	762,552	27	6	1	0	20	138,271	39	195
West	78	33	0	28	17	0	364,064	15	1	0	0	14	73,891	10	96
East	76	58	3	0	15	0	398,488	12	5	1	0	6	64,380	29	99
New York	41	21	0	0	0	20	54,100	0	0	0	0	0	0	41	14
North Dakota	31	19	0	0	12	0	220,123	10	1	0	0	9	61,735	0	55
Ohio	76	34	0	20	17	5	206,172	0	0	0	0	0	0	75	189
Oklahoma	487	246	19	24	174	24	1,714,784	60	10	3	5	42	284,059	110	792
Pennsylvania	16	0	0	14	2	0	103,752	1	0	0	0	1	5,690	0	59
Tennessee	3	1	0	0	2	0	1,480	2	0	0	0	2	995	3	6
Texas	1,362	756	33	86	472	15	5,704,810	281	23	4	4	250	1,229,303	122	1,069
Dist. 1	69	17	0	7	44	1	186,964	34	2	0	0	32	75,299	19	41
Dist. 2	36	9	3	8	16	0	212,588	7	0	0	2	5	50,721	0	42
Dist. 3	83	43	5	3	32	0	569,305	13	1	0	0	12	106,805	0	83
Dist. 4	87	29	6	3	49	0	367,004	26	1	1	0	24	124,166	0	47
East	107	61	5	0	41	0	448,745	25	0	0	0	25	123,265	0	54
Dist. 7-B	171	78	2	2	88	1	530,888	58	8	1	0	49	198,324	30	97
West	418	330	5	5	76	2	2,120,541	52	6	1	0	45	306,603	47	496
Dist. 9	278	137	0	16	114	11	796,666	57	3	0	2	52	173,625	26	98
Dist. 10	113	52	7	42	12	0	472,109	9	2	1	0	6	70,495	0	111
Utah	38	28	0	2	8	0	212,736	5	0	0	0	5	29,006	0	95
Washington	2	0	0	0	2	0	10,157	2	0	0	0	2	10,157	0	1
West Virginia	71	12	0	47	12	0	202,600	4	0	0	2	2	20,466	68	198
Wyoming	51	27	0	4	20	0	280,121	16	1	0	2	13	87,136	2	124
Feb. 1958	3,451	1,773	78	269	1,257	74	14,637,118	665	70	9	22	564	3,070,481	576	4,780
Jan. 1958	4,988	2,456	116	362	1,957	97	21,100,173	1,067	87	13	48	919	5,037,923	581	5,496
Cum. 1958	8,439	4,229	194	631	3,214	171	35,737,291	1,732	157	22	70	1,483	8,108,404	1,157	....
Cum. 1957	9,145	4,849	51	656	3,477	112	38,277,056	2,233	266	15	87	1,865	10,779,102	....	....

NOTE: C.T.—cable tool comp. Act. op.—active operations. D.D.—27: Kans. 1, Ohio 1, Mont. 1, Wyo. 3, N. M. 2, Ill. 3, Okla. 11, Texas 5 [Dist. 1 (1), Dist. 2 (2), Dist. 4 (2)].

	TOTAL WELLS						WILDCAT WELLS					
	Total	Oil	Gas	Dry	Footage	Cum. 1958	Total	Oil	Gas	Dry	Footage	Cum. 1958
Alberta	120	62	10	48	667,409	232	51	4	3	44	299,252	92
Saskatchewan	53	40	0	13	245,752	117	11	2	0	9	50,118	29
Manitoba	14	12	0	2	30,117	26	1	0	0	1	1,775	1
British Columbia	11	1	3	7	52,352	17	9	0	3	6	44,298	13
Western Canada	198	115	13	70	995,630	392	72	6	6	60	395,443	135

Big development seen in Northeast Ohio's Monroe pool

THREE NEW LOCATIONS were announced by Erie Natural Gas Co., Inc., for northeastern Ohio's Monroe Township pool, Ashtabula County. This area has had nine new gas wells and four oil strikes in recent months.

Erie's drilling will be on 900 acres of the Monroe Township pool where two wells were discovered in February on offsetting acreage. The two new wells are 1 Oroszy, drilled by Benedum-Trees Oil Co. and Plymouth Oil Co., which is making 45 bbl. of oil per day and the Felmont 1 Faro across the line in Pennsylvania which is making 24 bbl. per day and 350 M.c.f. of gas. In this same general area are the 1 Scribner, 2 Scribner, and 1 Fox, all Benedum-Trees wells.

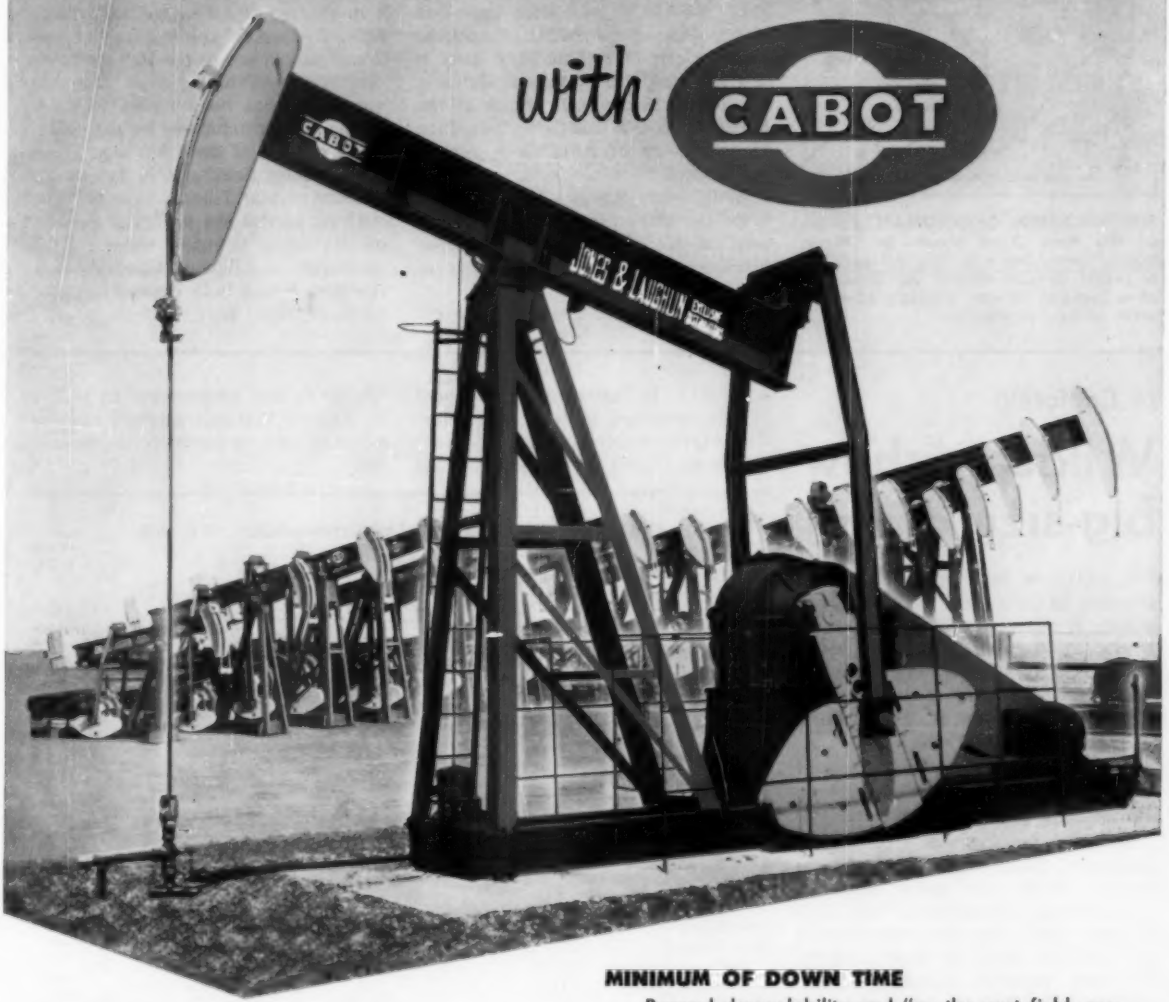
The new Erie wells are in Sections 25, 33, and 35 at Monroe. The 1 Murtha will be about ½ mile from the 1 Oroszy; the 1 Stasiak will be drilled about 1,500 ft. from 2 Scribner, following the 40-acre per well spacing of the new field. Total depth of each will be 3,500 ft. or to the top of the Queenston shale. At least four potential pay zones will be tested.

Erie has 26 locations for wells as a potential. Several other wells have been announced near existing production, and substantial gas production has been located about 4 miles north. This area is relatively untested, and no dry holes to depth are known.

DEPENDABLE RUGGED PUMPING

3,000 TO 32,000 POUNDS MAXIMUM POLISHED ROD LOAD

with CABOT



ADJUSTABLE CRANK BALANCED

Cabot adjustable crank pumping units are available in sizes from 7,000 to 32,000 pounds maximum polished rod load. Adjustments are simple. One man can make them from the ground. No heavy lifting. No complicated tools needed. All that's required is to loosen two bolts, move weights to desired position and tighten bolts. Single-piece inner weights easily added.

BEAM BALANCED

Cabot beam balanced pumping units are available in sizes from 3,000 to 11,000 pounds maximum polished rod load. Full beam counterweighting furnished. Weights can be easily installed any place along the beam without moving other weights. Safety rails provided. 15% crank counter weighting optional. Easily installed with two bolts.

MINIMUM OF DOWN TIME

Rugged dependability and "on the spot field service" provide a pumping unit assuring you of less down time. Cabot's 24-hour parts and maintenance shops at Odessa, Houston, Alice, Kilgore, Pampa, Compton, Great Bend, Lindsay, Seminole, Tulsa, Casper, Farmington, and Edmonton.

OIL FIELD PUMPING EQUIPMENT
CABOT
SHOPS, INC.
PAMPA, TEXAS
FRANKS
DIVISION OF CABOT

There's a quality Cabot pumping unit to meet your needs. Call your J&L Supply Man.

SOUTHWESTERN OKLAHOMA'S portion of the Palo Duro basin, or "Hollis basin," may have a new oil pool as a result of commercial oil showings at a Jackson County wildcat, 18 miles west of any production.

Rank strike indicated in Southwest Oklahoma

THE NEARLY oil-barren east end of the Palo Duro basin in extreme southwestern Oklahoma may have a new oil producer. Atlantic Refining Co. found commercial shows at the 1 Hulett in NE SE NW 5-1n-23w, 18 miles west of Altus field, nearest production.

A drill-stem test in what is thought to be the third Strawn-Pennsylvanian sand at 5,308-70 ft. got 110 ft. of black oil. Gravity is 45°. Testing continues.

Location of this possible discovery is in an area of little previous drilling activity. Success would liven interest in the eastern end of the Palo Duro or "Hollis" basin where very little oil production has been found to date.

The only production in the Oklahoma portion of the basin is at Altus field, Tipton field, and in the southwestern part of Tillman County. The only oil production in Texas' portion of the basin is many miles to the northwest in Oldham County's new Alamosa Ranch field, opened last year north of Vega, Tex.

In California

Wildcats show big-size drop

BECAUSE of the current oversupply situation in California, wildcatting has shown a substantial drop in recent weeks. A common complaint heard these days is of operators obtaining favorable wildcatting prospects, but getting flat turndowns when trying to get a crude contract.

However, wildcatting hasn't stopped entirely with these tests being among the more interesting in the state:

Hancock Oil Co. was preparing to complete 11-13 KCL, a wildcat located about 1½ miles northwest of Universal Consolidated Oil Co.'s Stevens sand new pool discovery in the Gosford field of Kern County. Hancock reported successful water shutoff at 7,900 ft. and was changing wellhead equipment in preparation for the completion try. No interval information was available but Hancock cleaned the 10,405 ft. hole to 9,500 ft.

Stevens sand production in the discovery area is at intervals around 9,500 ft.

Up in San Mateo County in the beautiful but rugged mountain region of LaHonda, Transierra Exploration Co. reports its wildcat in SW SW 17-7s-4w was flowing by heads at an unrevealed rate of 32.3° gravity crude, cutting around 80% water. Production was through a 16/64-in. choke. The perforated interval was 2,298-2,304 ft.

In Ventura County at the deep Fillmore field, Union Oil Co. abandoned a 15,117 ft. extension test about ½-mile southeast of field production. This expensive dry hole was originally drilled to 15,117 ft., plugged back to 10,369 ft. and whipstocked to 14,104 ft. Electric logs and sidewall samples failed to turn up commercial possibilities.

SERVICE-WELL DEPTH BREAKDOWN—FEBRUARY 1958

	A	B	C	D	E
Kansas	1	2	7	....	....
New York	....	20	....	....	....
Ohio	....	3	2	....	....
Oklahoma	11	10	2	1	....
Texas	3	9	1	1	1
Dist. 1	1	....	....	....	....
Dist. 7-B	....	....	....	1	....
West	....	1	....	....	1
Dist. 9	2	8	1	....	....
Total United States	15	44	12	2	1

FIELD CONDENSATE-WELL DEPTH BREAKDOWN—FEBRUARY 1958

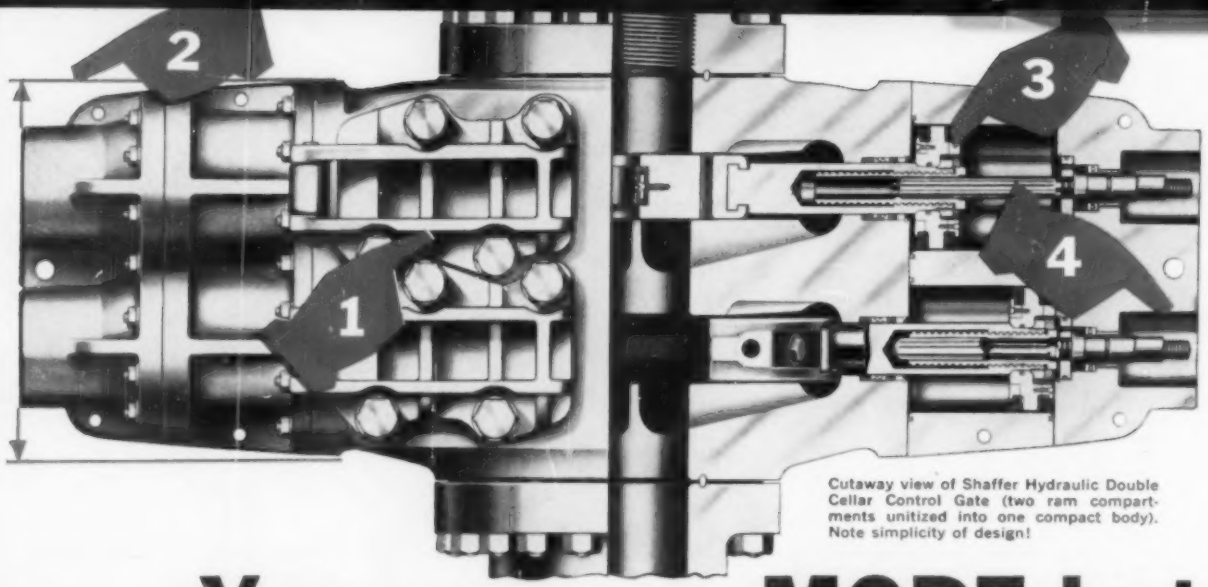
	A	B	C	D	E	F	G	H	I
Louisiana	....	....	....	....	....	3	6	6	4
South	....	....	....	....	....	3	6	5	4
Offshore	....	....	....	....	....	....	....	1	....
Mississippi	....	....	....	....	....	2	1	....	....
New Mexico	....	....	....	....	....	1	....	1	....
East	....	....	....	....	....	1	....	1	....
Oklahoma	....	....	....	1	6	6	1	....	2
Texas	....	....	....	....	8	15	4	2	....
Dist. 2	....	....	....	....	....	3	....	....	....
Dist. 3	....	....	....	....	2	1	2	....	....
Dist. 4	....	....	....	....	1	3	....	1	....
East	....	....	....	....	4	1	....	....	....
Dist. 7-B	....	....	....	....	1	....	....	....	....
West	....	....	....	....	....	1	2	1	....
Dist. 10	....	....	....	....	....	6	....	....	....
Total United States	....	....	....	1	14	27	12	9	6

WILDCAT CONDENSATE-WELL DEPTH BREAKDOWN—FEBRUARY 1958

	A	B	C	D	E	F	G	H	I
Louisiana	....	....	....	....	....	....	....	1	....
South	....	....	....	....	....	....	....	1	....
New Mexico	....	....	....	....	....	....	....	....	1
East	....	....	....	....	....	....	....	....	1
Oklahoma	....	....	1	....	2	....	....	....	....
Texas	....	....	1	1	....	2	....	....	....
Dist. 4	....	....	....	....	....	1	....	....	....
Dist. 7-B	....	....	....	1	....	....	....	....	....
West	....	....	1	....	....	....	....	....	....
Dist. 10	....	....	....	....	....	1	....	....	....
Total United States	....	....	2	1	2	2	....	1	1

How February field wells classified by depth

	OIL WELLS									GAS WELLS									DRY HOLES								
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Alabama	..	..	..	..	..	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Arkansas	..	18	4	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	8	..	..	1	..	..	..	..
California	23	13	19	17	16	9	3	2	1	..	..	..	..	1	..	..	..	..	2	4	4	2	5	3	..	1	..	..
Colorado	..	..	..	3	6	1	..	..	..	..	..	..	1	2	..	..	..	..	..	1	..	8	5	..	..	..	..	..
Illinois	4	37	30	1	..	..	..	..	..	4	..	..	..	..	..	..	..	..	3	16	29	..	..	..	..	..	..	..
Indiana	4	11	3	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	7	8	2	..	..	..	..	..	..	..
Kansas	..	20	58	45	4	..	..	..	..	..	2	2	2	1	..	..	..	..	2	2	46	18	5	..	..	..	..	..
Kentucky	10	4	1	..	..	..	..	..	..	1	1	5	..	..	..	..	..	..	11	5	..	..	..	..	..	..	..	..
Louisiana	2	15	6	2	24	25	16	8	2	1	4	..	..	..	2	2	2	..	1	3	8	1	4	9	16	10	5
North	2	14	6	..	11	..	..	..	..	1	4	..	..	..	2	..	..	..	1	3	8	1	3	3	1	..	..
South	..	1	..	2	7	13	10	5	2	..	..	..	..	..	..	2	2	..	..	..	..	..	..	5	13	9	5
Offshore	..	..	..	..	6	12	6	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	2	1	..
Michigan	..	2	5	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	1	..	1	..	..	..	..	..
Mississippi	..	..	..	..	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	2	..	..	..
Montana	..	6	..	1	..	5	..	..	..	..	..	..	..	..	..	..	..	..	1	1	2	..	..	1	..	..	..	..
Nebraska	..	..	1	..	10	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	16	..	..	..	..	..
New Mexico	..	9	17	27	20	4	8	..	..	1	7	3	6	11	..	..	..	..	1	2	4	2	1	..	2	..	..	..
West	..	1	3	8	19	1	..	..	..	1	7	3	6	11	..	..	..	..	1	1	..	1	..	..	..	..	..	..
East	..	8	14	19	1	3	8	..	..	..	..	..	..	..	..	..	..	..	..	1	4	1	1	..	2	..	..	..
New York	..	21	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
North Dakota	..	..	2	..	9	6	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	1	..	..
Ohio	2	3	29	..	..	..	..	..	..	2	2	11	5	..	..	..	..	..	6	4	7	..	..	..	..	..	..	..
Oklahoma	29	73	60	36	32	5	1	..	..	..	2	1	5	10	1	..	..	..	29	38	26	15	16	8	..	..	..	..
Pennsylvania	..	..	..	..	..	..	..	..	..	..	..	..	..	14	..	..	..	..	..	1	..	..	..	..	..	..	..	..
Texas	73	118	239	96	137	46	20	4	..	2	11	35	9	18	5	1	1	..	26	68	37	33	33	20	4	1	..
District 1	4	4	4	2	1	..	..	..	..	1	..	4	1	..	..	1	..	..	2	4	3	..	1	1	1	..	..
District 2	..	..	2	3	2	2	..	..	..	..	1	2	2	1	..	..	..	..	..	..	4	2	1	4	..	..	..	..
District 3	..	2	4	8	15	9	4	..	..	..	..	1	1	1	..	..	..	..	2	1	2	1	4	8	1	1	..	..
District 4	12	5	5	1	4	1	..	..	..	..	..	1	1	1	..	..	..	..	2	5	4	2	8	4	..	..	..	..
East	16	5	18	1	16	5	..	..	..	..	..	..	..	..	..	..	..	..	4	2	3	..	5	2	..	..	..	..
District 7-B	13	25	10	15	7	..	..	..	..	..	..	..	2	..	..	..	..	..	4	13	7	11	4	..	..	..	..	..
West	5	27	122	50	73	27	16	4	..	..	..	2	1	1	..	..	1	..	5	7	4	12	2	..	1	..	..	..
District 9	23	48	31	16	16	..	..	..	..	..	..	..	..	14	..	..	..	..	7	34	9	5	7	..	..	..	..	..
District 10	..	2	43	..	3	2	..	..	..	1	10	25	1	..	5	..	..	..	..	2	1	..	1	1	1	..	..	..
Utah	..	..	..	..	28	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	3	..	..	..	..	..
West Virginia	..	11	1	..	..	..	..	..	..	1	18	9	17	..	..	..	..	..	1	5	3	1	..	..	..	..	..	..
Wyoming	1	2	4	5	6	8	..	..	..	..	..	..	..	..	2	..	..	..	..	2	..	1	1	3	..	..	..	..
Tennessee	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total United States	149	363	479	237	295	110	53	14	3	15	47	67	45	57	10	3	3	..	90	163	177	82	91	48	24	13	5
Western Canada	..	12	6	49	32	10	..	..	..	..	3	2	..	1	1	..	..	..	..	3	2	5	..	..	..	..	..	..
Alberta	..	1	4	14	30	9	..	..	..	..	3	2	..	1	1	..	..	..	..	1	2	1	..	..	..	..	..	..
Saskatchewan	..	..	1	34	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	3	..	..	..	..	..	..
Manitoba	..	11	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
British Columbia	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..



Cutaway view of Shaffer Hydraulic Double Cellar Control Gate (two ram compartments unitized into one compact body). Note simplicity of design!

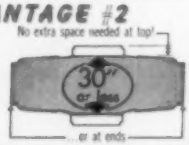
You can pay MORE but you can't buy BETTER than SHAFFER Cellar Control Gates

Before you buy your next cellar control gate equipment, check the field. Note the unique years-ahead features built into Shaffer Hydraulic Gates. Compare—and you'll find you can pay more for cellar control gates, but you can't buy better than Shaffer!

ADVANTAGE #1

Simply open convenient side doors to change rams—and closing the doors automatically aligns the new rams for proper operation. No extra room is needed above the gate—nor is added space required at the ends—to change rams. Moreover, complete ram changes can be made whether the pipe is in or out of the hole!

ADVANTAGE #2

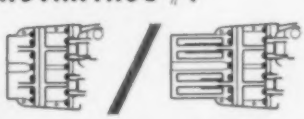


Shaffer Gates are not only compact in all three dimensions—length, width and height—but there's no need to expand the gates endwise to change rams, nor need extra space be allowed above the gates for lifting out the rams. Even sizes as large as 13⅝" (12" Series 900) are only 18½" high in Single Gates—only 30" high in Double Gates!

ADVANTAGE #3

In Shaffer Gates there are no complicated yokes, no secondary connections between pistons and rams. For maximum safety and simplicity, each ram is operated by a single direct-connected piston!

ADVANTAGE #4



Whether you prefer the extra compactness of a non-rising locking shaft, or the quick indication of ram position afforded by a rising shaft, you choose the design you prefer when you select Shaffer Gates!

In addition, Shaffer Gates have *Self-Draining Compartment Bottoms* (no detrimental sand or mud accumulates to interfere with free ram travel)... *Completely Enclosed Design* (no exposed moving parts to become damaged or corroded)... *Built-In Flow Connections*, and many other unsurpassed features that add up to greater safety, greater dependability, greater convenience. Get the full story from your nearest Shaffer representative—or write direct for further details!

FREE! Send for your copy of the complete Shaffer Catalog.

See the Shaffer section of your latest Composite Catalog.

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HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

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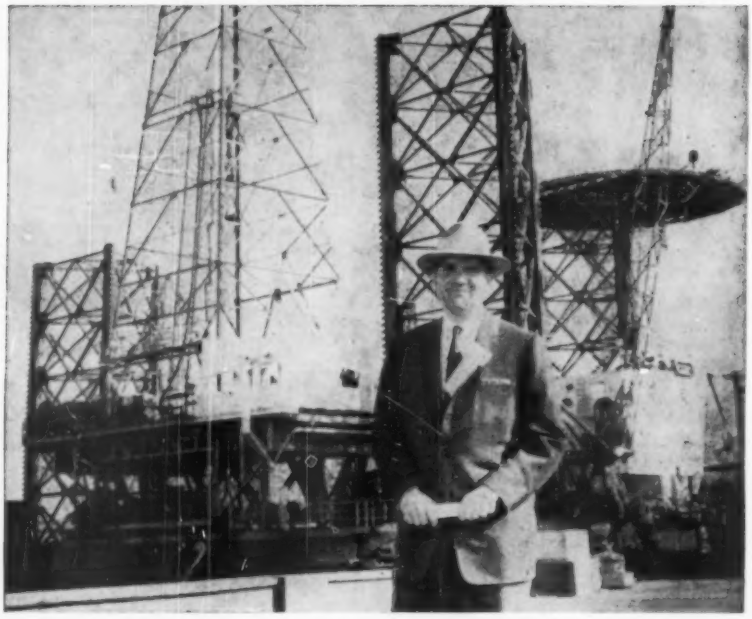
FARMINGTON, NEW MEXICO, Shaffer Tool Works, Post Office Box 546
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
HOUMA, LOUISIANA, Shaffer Tool Works, Post Office Box 827
EXPORT SALES OFFICE Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

35 years OF OIL TOOL LEADERSHIP

How February wildcats classified by depth

	OIL DISCOVERIES									GAS DISCOVERIES									DRY HOLES								
	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I	A	B	C	D	E	F	G	H	I
Alabama	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	..
Arizona	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	3	..	..	..	..	..	..	..	..
Arkansas	..	..	1	1	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1	3	..	3	..	..	..	..	..
California	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	5	2	6	3	1	3	..	..	..
Colorado	..	..	1	..	2	..	..	..	..	..	..	..	..	2	..	..	..	..	1	1	..	11	23	..	..	..	..	..
Illinois	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	5	10	..	..	..	..	..	..	..
Indiana	1	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	11	1	..	..	..	..	..	..	..	..
Kansas	..	..	1	4	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	3	14	21	4	..	..	..	..	..
Kentucky	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3	1	..	..	..	..	..	..	..	..
Louisiana	..	..	..	..	1	..	2	..	..	..	..	..	..	..	2	..	..	..	..	..	1	1	1	2	10	1	1
North	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	1	1	1	..	..	..	..	..
South	..	..	..	..	1	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	10	1	1
Offshore	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Michigan	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	3	5	..	..	..	..	..	..	..
Mississippi	..	..	..	..	1	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	7	2	2	1	..	..
Montana	..	2	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	1	4	..	2	..	..	..
Nebraska	..	..	..	2	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	3	11	..	..	..	..	..
New Mexico	1	..	..	2	1	1	1	..	..	..	..	..	..	..	..	..	..	..	2	4	2	1	10	1	..	..	..	..
West	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1	2	1	1	8	1	..	..	..	..
East	1	..	..	2	1	..	1	..	..	..	..	..	..	..	..	..	..	..	1	2	1	..	2	..	..	..	..	..
North Dakota	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	3	3	1	1	..	..
Oklahoma	..	2	..	3	3	..	2	..	..	..	..	..	..	4	1	..	..	..	2	10	10	5	10	5	..	..	..	..
Pennsylvania	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..
Tennesssee	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..
Texas	1	3	3	3	8	3	1	1	..	..	..	..	1	2	1	..	..	..	17	63	52	37	50	17	11	3	..	..
District 1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	6	15	6	5	..	..	..	..	..	..
District 2	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	2	1	1	1	..	..	..
District 3	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	5	6	1	..	..	..
District 4	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	2	3	9	1	4	3	2	..	..	..
East	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	3	5	12	2	..	..	..	..
Dist. 7-B	..	3	2	2	1	..	..	..	..	..	..	..	..	..	..	..	..	..	2	19	8	8	12	..	..	..	..	..
West	..	..	..	..	4	1	1	..	..	..	..	..	..	..	..	..	..	..	2	5	11	6	9	3	6	3	..	..
District 9	..	..	1	1	1	..	..	..	..	..	..	..	..	2	..	..	..	..	4	19	15	9	5	..	..	..	..	..
District 10	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	2	1	..	..	..
Utah	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	2	1	..	..	..	..
Washington	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..
West Virginia	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	1	1	..	..	..	..	..
Wyoming	..	..	..	..	1	..	..	..	..	..	..	..	..	..	2	..	..	..	1	3	1	2	3	2	..	1	..	..
Total United States	3	8	8	15	22	5	8	1	..	..	2	1	2	10	7	..	..	..	52	106	106	92	139	33	29	6	1	
Western Canada	..	..	..	..	3	3	..	..	..	..	1	..	3	1	..	..	1	..	1	3	12	14	24	1	4	..	1	
Alberta	..	..	..	..	1	3	..	..	..	..	1	..	1	..	..	..	1	..	1	1	10	8	18	1	4	..	1	
Saskatchewan	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	3	3	..	..	..	..	..
Manitoba	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
British Columbia	..	..	..	..	..	..	..	..	..	..	..	..	2	1	..	..	..	..	..	..	..	3	3	..	..	..	..	..



C. E. **THORNTON** and the "C. E. Thornton."

Contractor Stays on the Go

. . . helping direct Reading & Bates' 15-rig operation in the U.S., Gulf of Mexico, and in Canada and Venezuela.

READING & BATES Offshore Drilling Co. has an executive vice president named C. E. Thornton and a new $3-million drilling barge by the same name.

If the machine keeps as busy as the man it is named for, then Reading & Bates has a bright future offshore.

Charlie Thornton has to work hard to keep abreast of his duties with R & B Offshore and its three associated drilling companies. He holds an executive position with each of the firms and helps run a drilling operation that stretches from Fort St. John in northern British Columbia to the Barinas area of southern Venezuela.

The new LeTourneau drilling barge was christened March 22 in New Orleans. Immediately following the ceremonies, it was towed to Block 115 in the East Cameron area off Louisiana under contract to the CATC group.

The barge, which will drill in water up to 90 ft. deep, will add diversification to R & B's offshore equipment as well as give the company a chance to handle more jobs. When the company extended its operations offshore 3 years ago, it did so with two Levingston tenders, complete with rigs operating from permanent platforms. These two units currently are working for CATC and Shell Oil Co.

Beating high costs . . . Like any other offshore contractor, R & B is facing mounting operational costs.

But Charlie Thornton and J. W. Bates, Jr., president of the offshore company, have worked up some ideas on how to cut these costs and still give the customer good service.

One idea is to tailor equipment for each job—if it is a 12,000-ft. well, they use equipment designed for that depth rather than a rig that will drill thousands of feet deeper. Thornton admits this takes cooperation on the part of operating companies, but sees it as a way to trim costs without sacrificing service.

Many firms operating in the Gulf of Mexico require an offshore contractor to use equipment capable of drilling to 25,000 ft.—yet no hole near that depth has been drilled. Hundreds of dollars in daily operating costs can be saved by gearing equipment more realistically to the needs of a specific job.

Thornton is concerned about the high offshore costs, but says drilling contractors have licked other problems —including crooked holes and high pressures—and can overcome the offshore costs problem with more experience.

Started in teens . . . At 31, Thornton has more experience than his age indicates. He learned the business from the ground up. When 15, he started to work for Gulf Oil Corp. as a part-time employe in Tulsa.

After 3 years' service during World War II with the Army Corps of Engineers, Thornton returned to Tulsa and a full-time job with Gulf. He also entered the University of Tulsa, where

Personals

E. J. Stufflebeam, tool pusher, has been transferred to Homer, La., from Marlow, Okla., by Big Chief Drilling Co.

John J. Albrecht, division gas engineer for The California Co. at Natchez, Miss., has been appointed assistant chief engineer (gas engineering). He will headquarter in New Orleans. Albrecht succeeds the late G. M. Liljenstein.

M. M. Rogers, district superintendent for Humble Oil & Refining Co., has been transferred to Wink, Tex., from Hobbs, N. M.

F. J. Toth, Denver division production manager for Shell Oil Co., has been named production superintendent in the Denver area. He succeeds **J. W. Roche,** who was appointed Calgary area production manager for Shell several months ago. **T. S. Zajac,** chief mechanical engineer, will replace Toth temporarily as Denver division production manager.

Frank P. Sonnenberg, Billings, Mont., consulting geologist, has been named chief geologist of Chaco Petroleum, S.A., subsidiary of Tennessee Gas Transmission Co., operating in Bolivia.

H. P. Wickham, manager of the operating division, process department, for M. W. Kellogg Co., has been appointed manager of the newly organized project - engineering department. The new department combines the operating division with project engineering.

he graduated in 1949 as a petroleum engineer.

He stayed with Gulf 2 years after graduating, working in Oklahoma, New Mexico, and Alberta in the production and drilling departments.

In 1951 he helped found Reading & Bates, Ltd., at Calgary. The company started as a one-rig operation and now has seven rigs running. He has been president of the Canadian company since its organization, living in Calgary 5 years, then moving to Denver. Last October he returned to Tulsa as president of Reading & Bates, Inc., the parent company.

Thornton frequently visits the company's Venezuelan operation, which is a one-rig setup that is slated to grow. But the growth in Venezuela will be gradual, following the pattern set in Canada and offshore.

Sell the public . . . Thornton devotes as much time as possible to civic work. He feels he is serving two purposes: Doing something for the community and doing a public-relations job for the industry.

His attitude is one all oil men might well adopt—particularly at a time when the industry is taking such a beating in Washington and Ottawa and in many influential daily newspapers.

Some oil men, he says, have a habit of moving into a town, using its facilities, but contributing little to the civic activities or growth of the community.

"The petroleum industry could enhance its position with the public if oil men would take more time for civic work and sell their problems to their neighbors."

Thornton believes in this policy and is doing what he can to follow it. While in Canada, he served during 1955 as president of the Canadian Drilling Contractors Association and recently accepted an appointment as a director of the Tulsa Chamber of Commerce.

W. Ray Staples, Dallas consultant, has been named president of Georesearch, Inc.

F. B. Van Shoubrouek, assistant superintendent for Humble Oil & Refining Co. in Hobbs, N. M., has been transferred to Pampa, Tex., in the same capacity.

R. J. Funk has been transferred by Anderson - Prichard Oil Corp. from Oklahoma City, where he was district foreman, to Denver, where he will be production engineer-district foreman.

Harold R. Porter, senior product engineer, has been promoted to assistant manager, product-engineering department, for Standard Oil Co. of California.

Arthur S. Hall, formerly associated with Duff & Phelps, has been named administrative assistant for Southeastern Michigan Gas Co. in Port Huron, Mich.

Roger Richardson, associate manager of refinery liaison for Esso Research & Engineering Co., has been named manager. He succeeds **H. G. M. Fischer,** who becomes consultant on refinery and processing matters.

Vern Howell, Cities Service Oil Co. geologist, has been transferred to Billings, Mont., from Bismarck, N. D. **Gus Keller,** formerly in Liberal, Kans., will replace Howell in Bismarck.

D. B. Vale, executive vice president of Shell Oil Co. of Canada, **P. L. Kartzke,** vice president for exploration and production, and **G. Davidson,** vice president for manufacturing, have been named directors of the company.

H. A. Proctor, manager of engineering for Southern California Gas Co., has been elected vice president in charge of engineering and transmission. **S. A. Bradfield,** manager of transmission, has been named manager of engineering succeeding Proctor. **T. S. Miller,** supervisor of system planning, replaces Bradfield. **A. M. Lawson,** San Joaquin Valley division engineer, will succeed Miller.

Arthur J. Helmbrecht, vice president and a director of Buckeye Pipe Line Co., has been elected executive vice president. Helmbrecht, a graduate of Stevens Institute of Technology, joined Buckeye as assistant to the chief engineer. He was later chief engineer, assistant to the president, and became vice president in 1955.

Curtis H. Johnson, formerly area manager in Europe, Africa, and the Middle East for Geophysical Service, Inc., has opened consulting offices in Los Angeles. Johnson joined Geophysical Service in 1953 as division manager, offshore. He had been assistant chief geophysicist with General Petroleum Corp. before that time.

Personals

Maland Is Nomads Chairman

Herb E. Maland, vice president of R. J. Eiche & Associates, Inc., has been elected 1958 chairman of the Nomads National Board of Regents, top office in the national society. Maurice F. Delano, Jr., R. S. Stokvis & Sons, Inc., has been named secretary-treasurer. Both men have been active in the New York Nomads chapter. Maland is a charter member of the group and served as president in 1956, junior regent last year, and is now senior regent. Delano is also a past president and is 1958 junior regent.

C. W. Butler, assistant to the director of Gulf Research & Development Co.'s automotive-engineering division, Pittsburgh, has moved up to division director. He succeeds **J. E. Taylor,** recently transferred to Detroit as director of automotive research.

E. V. McCollum, senior partner of E. V. McCollum & Co., Tulsa, and **Bart W. Sorge,** vice president of United Geophysical Corp., Pasadena, Calif., have been nominated for president of the Society of Exploration Geophysicists. Election will be in June and July by mail ballot. Nominated for vice president are **Fred J. Agnich,** president of Geophysical Service, Inc., Dallas, and **William M. Erdahl,** chief geophysicist, Skelly Oil Co., Tulsa. **Robert Dyk,** chief geophysicist of Tidewater Oil Co., San Francisco, and **Kenneth R. Wells,** vice president of General Geophysical Co., New Orleans, are candidates for secretary-treasurer. **Dr. L. Y. Faust,** geophysical supervisor of Amerada Petroleum Corp., Tulsa, will continue as editor. Officers will be installed at the society's annual meeting October 13-16 in San Antonio.

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*ARKANSAS: Magnolia; COLORADO: Sterling; KANSAS: Great Bend; LOUISIANA: Shreveport; MISSISSIPPI: Laurel, Natchez; NEBRASKA: Kimball; NEW MEXICO: Farmington; OKLAHOMA: Duncan, Oklahoma City; TEXAS: Abilene, Alice, Albany, Borger, Wichita Falls, Kilgore, Houston, Pampa, Odessa; WYOMING: Casper

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Personals

William H. Young, general manager of Felmont Oil Corp.'s Bradford, Pa., division, has been elected vice president of the company, the domestic operating subsidiary of American Maracaibo Co. Young joined Felmont in 1954 as manager of the Bradford division in charge of area oil and gas exploration and development, pipeline construction and production and sale of water for operators in the Bradford field. He will continue to headquarter in Bradford.

E. Charles Patton has resigned as chief engineer of Tekoil Corp. to become an independent operator. Patton was president of Reservoir Engineering Laboratories, Inc., before its acquisition by Tekoil last year. He was 1948 recipient of the Raymond Memorial Award of Society of Petroleum Engineers for his work in reservoir engineering.

Arthur H. Davis, formerly with Shell Oil Co. in Denver, has joined Arabian American Oil Co. as a senior engineer in the producing and pipelines department. **Harry W. Snady,** equipment engineer with Creole Petroleum Corp. in Venezuela for 8 years, has transferred to Aramco's engineering department. **Wilfred F. Herbert,** formerly a chemical engineer with Du Pont in Orange, Tex., has joined Aramco's manufacturing and oil supplies department.

Harry J. Kennedy, Continental Oil Co., Houston, has been reelected president of the Western Petroleum Refiners Association. Five vice presidents, also reelected, include **Rex S. Blazer,** Ashland Oil & Refining Co., Ashland, Ky.; **William J. Carthaus,** Great Northern Oil Co., St. Paul, Minn.; **Walter Famariss, Jr.,** Famariss Oil & Refining Co., Hobbs, N. M.; **F. L. Martin,** Suntide Refining Co., Corpus Christi, Tex.; and **Jack A. Vickers,** Vickers Petroleum Co., Wichita, Kans. New WPRA directors are **O. C. Johnson,** Socony Mobil Oil Co., New York; **John F. Lynch,** La Gloria Oil & Gas Corp., Tyler, Tex.; **W. S. Peeler,** American Oil Co., New York; **Fred P. Sewell,** Delhi-Taylor Oil Corp., Dallas; **J. H. Sheehan,** Lion Oil Co., Eldorado, Ark.; **W. G. Tierney,** Derby Refining Co., Wichita; and **Leo J. Wilmeth,** Shamrock Oil & Gas Corp., Amarillo.

Myles C. Marek has been promoted to superintendent of Sunray Mid-Continent Oil Co.'s Placedo McFaddin, Tex., area. Marek, formerly operating foreman, replaces the late O. C. Dillon. **Hilmon Mitchell,** junior engineer in Corpus Christi, Tex., will succeed Marek as operating foreman.

J. Ronald Getty has resigned as Tidewater Oil Co.'s administrative vice president for marketing. He will join Getty Oil Co. in Europe in a senior management position. He will continue as a director of Tidewater. One of Getty's former assignments was managing director of Veedol G.m.b.H. and Tidewater export manager for Europe, Africa, and the Middle East. He headquartered in Germany at that time.

R. L. Wells has been appointed assistant district superintendent at Standish, Mo., for Sinclair Pipe Line Co. **F. W. Daugherty** has been named assistant district superintendent at Mechanicsburg, Pa., **Virgil Oldham** becomes assistant district superintendent at Toledo, Ohio, and **John L. Rindosh** is promoted to assistant superintendent at the Mazon, Ill., district. In other appointments **N. E. Gustafson** becomes terminal foreman at Woodbury, N. J., and **Eugene E. Kline** is promoted to senior engineer at Mazon.

P. J. MERKUS

P. J. Merkus, manager of Shell Oil Co.'s Wilmington, Calif., refinery, has been named manager of the Wood River, Ill., refinery. He succeeds **H. D. Dale,** who has retired after 33 years with Shell. **G. C. Montgomery,** superintendent at Wilmington, moves up to manager there succeeding Merkus. Montgomery will be succeeded by **J. B. St. Clair,** assistant superintendent at the Martinez, Calif., refinery. **E. A. Baliman,** formerly assistant manager of the Shellburn refinery of Shell Oil Co. of Canda, will succeed St. Clair at Martinez.

James O. Breene, executive vice president of Winona Oil Co. of Delaware, has been elected president. He will headquarter in Tulsa at the company's general offices there. He succeeds his father, **E. C. Breene,** president of the company since 1924, who becomes chairman of the board. In other appointments **L. A. Payne,** formerly assistant secretary, has been named a vice president.

DEATHS

Everett R. Filley, senior vice president who headed the world-wide producing activities of The Texas Co., died last week at his Greenwich, Conn., home. Filley, 63, started his career in oil in 1914 with Producers Oil Co., later a Texaco subsidiary. He rose to general manager of Texaco's Houston producing department in 1949. In 1953 he was made a vice president of the company in charge of producing activities. Last year Filley was promoted to the world-wide producing job with the title of senior vice president. He was also president of Texaco Exploration Co., and a director of Halliburton Oil Well Cementing Co., Texaco Development Corp., and Texas-Zinc Minerals Corp.

Raymond Harvey, who retired last year as chief oil dispatcher with Service Pipe Line Co., died March 23 in Tulsa. He was 65.

William Hardin Perkins, 52, Duncan, Okla., drilling contractor, died March 21 in a Dallas hospital.

Ed Schoonover, 88, retired independent operator, died March 20 at his home in Tulsa. Schoonover was a production foreman for Tidewater Oil Co. before becoming an independent in the 1930's. He retired in 1955.

Frank Diller, 58, Abilene, Tex., drilling contractor, died March 18 in Abilene.

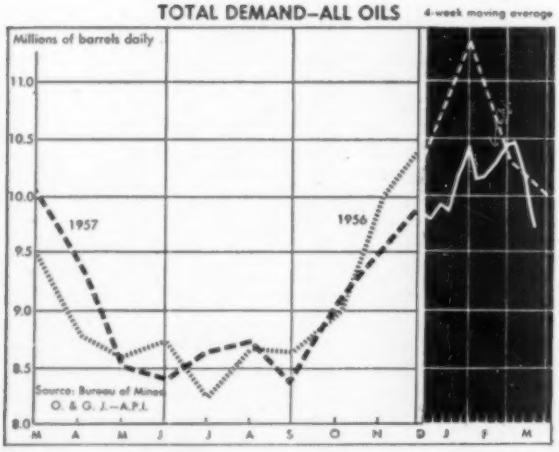
Warren Dewees Forster, 66, corporate secretary of Sunray Mid-Continent Oil Co., died March 22 in Tulsa. Forster had been with Sunray since 1921. He was to have retired July 1. Forster was a director of Sunray before its merger with Mid-Continent Petroleum Corp. in 1955.

George Leo Switzer, 61, retired marketing retail manager for Shell Oil Co., died March 15 in Fort Lauderdale, Fla. Switzer had been with Shell since 1929. He was the son of Gustave Switzer, one of the founders of the old Socony-Vacuum Oil Co., now Socony Mobil Oil.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	6,285,225	UP	15,725	DOWN	1,470,466
Crude stocks	283,846,000	DOWN	1,970,000	UP	31,925,000
Completions	855	UP	22	DOWN	311
Refinery runs	7,316,000	DOWN	163,000	DOWN	660,000
Gasoline stocks	216,907,000	UP	382,000	UP	11,386,000
Kerosine stocks	17,178,000	DOWN	281,000	DOWN	2,800,000
Distillate stocks	78,449,000	DOWN	3,404,000	UP	846,000
Residual stocks	55,013,000	DOWN	48,000	UP	18,127,000
Four-product stocks	367,547,000	DOWN	3,351,000	UP	27,559,000
Total imports	1,567,900	UP	35,400	UP	311,500



Oil needs a big stock drop in April, but won't get it

CRUDE AND PRODUCT STOCKS in this country are too high. Every crude producer and every refiner would agree with that statement. What many of them fail to realize is that stock corrections in April will be less than in March.

Here is how the supply-demand picture balances out for the month of April. Announced allowables and seasonal changes indicate a drop in crude production of no more than 50,000 bbl. daily. Current production figures for March average about 6,300,000 bbl. daily. Part of the cut scheduled for Texas in April will be offset by new production in other states where basic allowables were unchanged. Total production for the month can be expected to average at least 6,250,000 bbl. daily.

According to the latest reports to the Texas Railroad Commission, importers plan to bring in about 90,000 bbl. daily more crude in April than in March. Production at natural-gasoline and cycling plants will be down about 16,000 bbl. daily in April. Reports to the Texas Railroad Commission also indicated a probable drop in product imports of about 160,000 bbl. daily.

The net reduction in new supply for April will be about 135,000 bbl. daily, made up from cuts in crude, gas-liquids production, and product imports but offset in part by higher crude imports.

Demand will be lower in April. For the postwar period, domestic demand in April has averaged 5.7% lower than in March. Exports, as a rule, are slightly higher in April to give an average reduction in total demand of about 4.7%.

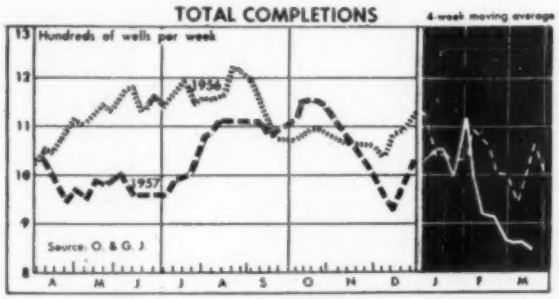
If demand follows the normal seasonal pattern this year, the total for April will be about 440,000 bbl. daily less than March. With a cut of only 135,000 bbl. daily in total supply, the net stock change for April will differ from March by about 9,000,000 bbl.

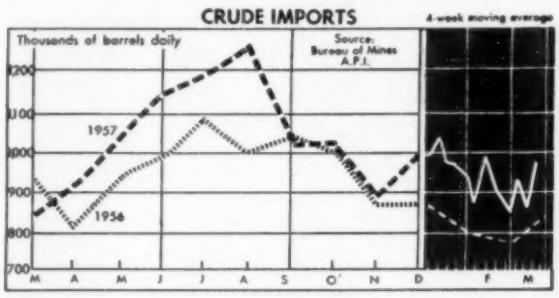
In normal years, stocks decrease slightly in March and increase in April. But this is one year when the industry would profit from a big stock cut in April.

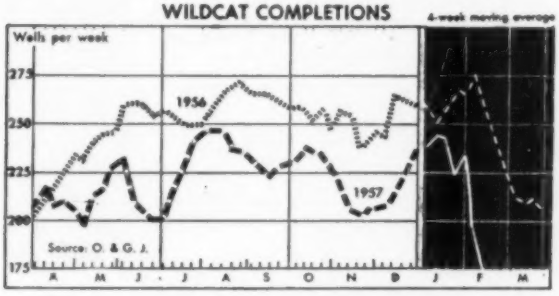
Market reactions . . . Many unbranded jobbers are hoping that gasoline prices will not go any lower on the spot market. Their reasoning is like this. Lower spot prices for gasoline at this time will indicate enough weakness in the market to justify tank-wagon reductions. Since tank-wagon postings are the bases of the jobber's selling prices, any spot-market reduction that would change tank-wagon prices could mean less profit for the jobber.

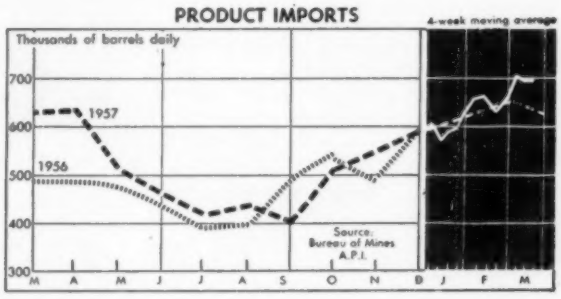
Standard Oil Co. (Ind.) reduced tank-wagon prices for gasoline in the Chicago area, and Continental Oil Co. made a few downward adjustments in Oklahoma.

Heavy fuel is a little firmer in the Group 3 area with some refiners starting production of asphalt and road oil.







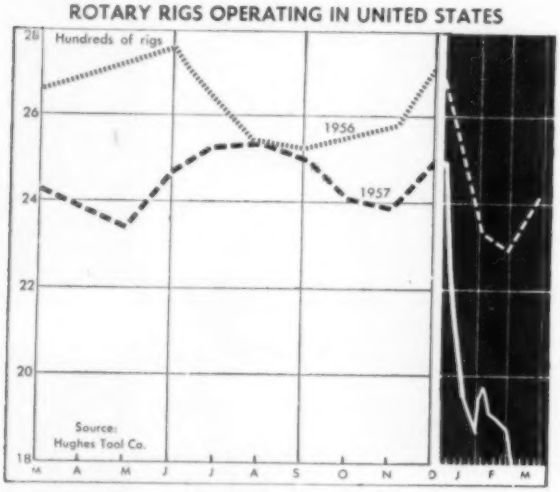


WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 22, 1958

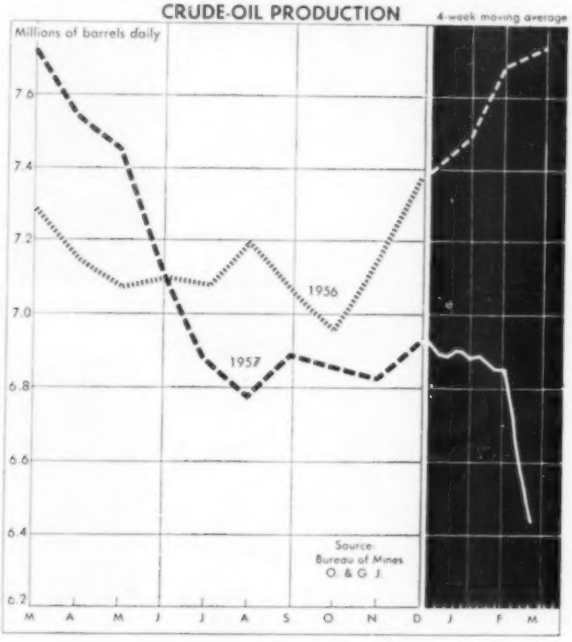
	Total wells							Cumulative		Total wildcats					Cumulative	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1958	1957	Total	Crude	Cond.	Gas	Dry	1958	1957
Alabama	4	3	0	0	1	0	36,588	19	20	1	0	0	0	1	7	8
Arkansas	12	3	0	2	7	0	47,152	151	239	7	0	0	2	5	37	35
California	30	17	0	0	13	0	210,317	464	474	7	0	0	0	7	85	125
Colorado	8	3	0	0	5	0	39,552	168	243	4	0	0	0	4	91	164
Illinois	32	12	0	1	19	0	69,855	450	536	8	0	0	1	7	86	131
Indiana	8	5	0	0	3	0	13,785	161	143	0	0	0	0	0	55	28
Kansas	86	40	0	9	33	4	294,227	936	1,001	13	4	0	0	9	185	172
Kentucky	17	6	0	3	8	0	23,668	190	327	2	0	0	0	2	26	73
Louisiana	62	37	5	2	18	0	546,295	748	884	8	1	0	0	7	91	142
North	15	10	0	1	4	0	61,276	266	335	2	0	0	0	2	36	37
South	39	23	5	1	10	0	409,462	382	396	4	1	0	0	3	49	86
Offshore	8	4	0	0	4	0	75,557	100	153	2	0	0	0	2	6	19
Michigan	8	3	0	1	4	0	20,550	72	89	3	0	0	1	2	28	39
Mississippi	5	1	0	0	4	0	40,953	90	76	2	1	0	0	1	49	36
Montana	6	2	0	0	4	0	43,746	91	68	3	0	0	0	3	43	24
Nebraska	21	5	0	0	16	0	125,398	163	174	10	1	0	0	9	80	97
New Mexico	31	17	0	7	7	0	149,231	501	448	7	2	0	0	5	75	71
West	13	6	0	6	1	0	64,941	245	164	3	2	0	0	1	37	28
East	18	11	0	1	6	0	84,290	256	284	4	0	0	0	4	38	43
New York	10	5	0	0	0	5	13,500	121	....	0	0	0	0	0	9	....
North Dakota	11	8	0	0	3	0	81,144	102	75	2	1	0	0	1	36	30
Ohio	29	16	0	7	5	1	75,129	212	234	0	0	0	0	0	3	3
Oklahoma	112	49	3	14	41	5	377,515	1,622	1,538	10	1	0	0	9	222	173
Pennsylvania	7	0	0	2	5	0	41,434	23	*412	3	0	0	1	2	4	*24
Texas	320	177	6	23	113	1	1,196,701	4,221	4,995	61	5	1	1	54	892	1,387
Dist. 1	6	3	0	0	3	0	14,225	200	254	3	0	0	0	3	80	99
Dist. 2	8	5	0	1	2	0	42,519	129	156	1	0	0	0	1	34	70
Dist. 3	25	9	1	1	14	0	173,145	287	432	7	0	0	0	7	52	146
Dist. 4	18	5	2	0	11	0	97,626	260	323	6	0	1	0	5	85	123
East	23	11	1	0	11	0	71,187	305	284	5	0	0	0	5	87	87
Dist. 7-B	77	40	0	2	35	0	195,357	542	683	20	4	0	0	16	167	254
West	69	53	1	2	13	0	322,681	1,257	1,413	5	0	0	0	5	195	240
Dist. 9	68	41	0	3	23	1	189,999	920	1,144	12	1	0	0	11	166	342
Dist. 10	26	10	1	14	1	0	89,962	321	306	2	0	0	1	1	26	26
Utah	5	2	0	0	3	0	30,383	106	34	2	0	0	0	2	19	21
West Virginia	18	2	0	11	5	0	53,142	174	160	0	0	0	0	0	6	9
Wyoming	13	8	0	1	4	0	55,673	191	193	2	0	0	0	2	66	70
Miscellaneous	0	0	0	0	0	0	0	28	19	0	0	0	0	0	22	13
Total U. S.	855	421	14	83	321	16	3,585,938	11,004	12,382	155	16	1	6	132	2,217	2,875
Total prev. week	833	443	12	62	289	27	3,504,144	.....	.....	162	17	2	6	137	.....	.....
Cum. 1958	11,004	5,546	244	818	4,166	230	46,479,979	.....	.....	2,217	211	27	83	1,896	.....	.....
Western Canada	55	20	0	5	27	3	299,714	572	592	26	0	0	2	24	209	169

*Includes New York.

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL PRODUCTION



ACTIVE ROTARY RIGS*

	3-24-58	3-17-58	3-10-58	3-25-57
Alabama	6	5	6	12
Arkansas	16	20	20	20
Arizona	....	....	1	....
California	77	80	84	96
Colorado	32	27	22	37
Florida	2	1	2	2
Georgia	....	....	....	1
Idaho	....	....	....	....
Illinois	18	15	18	43
Indiana	3	1	1	5
Iowa	3	3	....	2
Kansas	68	71	84	169
Kentucky	1	1	3	6
Louisiana	316	327	314	431
North	26	29	22	51
South	230	237	231	281
Offshore	60	61	61	99
Maryland	....	....	....	1
Michigan	7	7	8	7
Missouri	....	....	....	....
Montana	18	21	22	24
Mississippi	32	34	36	19
Nebraska	13	12	19	30
Nevada	....	....	....	....
New Mexico	100	109	100	124
New York	1	1	1	1
North Dakota	38	33	34	22
Ohio	....	....	....	....
Oklahoma	147	132	183	231
Oregon	....	....	....	1
Pennsylvania	12	12	12	13
South Dakota	....	....	....	1
Texas	723	699	738	1,020
Gulf Coast	160	156	153	213
Offshore	2	3	2	7
West	291	293	309	403
North	233	207	233	350
East	37	40	41	47
Tennessee	....	....	....	....
Utah	37	38	42	31
Washington	2	2	1	....
West Virginia	3	4	4	1
Wyoming	38	39	42	46
Virginia	....	....	....	....
Total United States	1,713	1,694	1,797	2,396
Western Canada	180	208	216	225
Eastern Canada	2	1	....	....
Grand total	1,895	1,903	2,013	2,621

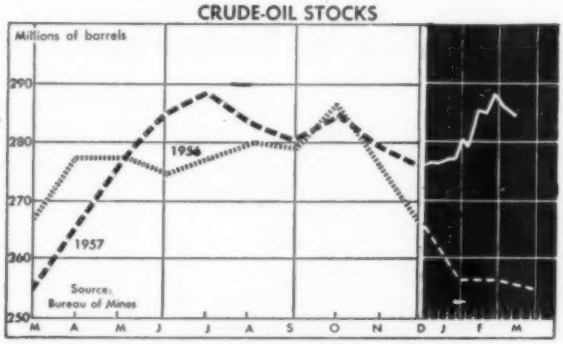
*Hughes Tool Co.

DAILY AVERAGE PRODUCTION FOR WEEK

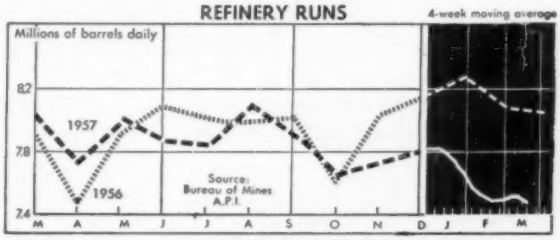
	March 22, 1958			Mar. 15
	Crude oil	Lease condensate	Total	total
Alabama	15,925	.....	15,925	16,000
Arkansas	83,000	200	83,200	83,250
California	883,700	.....	883,700	885,100
Colorado	141,000	.....	141,000	141,600
Eastern	48,000	.....	48,000	48,400
Florida	1,275	.....	1,275	1,275
Illinois	229,400	.....	229,400	233,700
Indiana	32,100	.....	32,100	26,900
Kansas	†281,125	.....	†281,125	†283,750
Kentucky	39,600	.....	39,600	39,700
Louisiana	729,775	89,300	819,075	818,850
North	112,025	2,800	114,825	114,600
South	617,750	86,500	704,250	704,250
Michigan	24,200	.....	24,200	24,200
Mississippi	99,400	4,975	104,375	104,375
Montana	75,100	.....	75,100	76,600
Nebraska	52,800	.....	52,800	54,175
Nevada	150	.....	150	150
New Mexico	258,500	6,600	265,100	264,875
North Dakota	34,450	.....	34,450	31,700
Oklahoma	†522,250	.....	†522,250	†500,700
Texas	2,238,000	63,850	2,301,850	2,301,850
Dist. 1	44,000	500	44,500	44,500
Dist. 2	93,000	9,300	102,300	102,300
Dist. 3	327,000	32,000	359,000	359,000
Dist. 4	161,000	7,400	168,400	168,400
Dist. 5	28,000	400	28,400	28,400
Dist. 6	100,000	7,400	107,400	107,400
East Texas Field	125,000	.....	125,000	125,000
Dist. 7-B	132,000	150	132,150	132,150
Dist. 7-C	115,000	3,650	118,650	118,650
Dist. 8	816,000	1,500	817,500	817,500
Dist. 9	190,000	900	190,900	190,900
Dist. 10	107,000	650	107,650	107,650
Utah	18,200	.....	18,200	22,300
Wyoming	312,150	.....	312,150	309,850
Others	‡200	.....	‡200	‡200
Total U. S.	6,120,300	164,925	6,285,225	6,269,500
Change from prev. week, up			15,725	
Canada	†505,300	.....	†505,300	†464,700
Total U. S. Prod.—Jan. 1-Mar. 22				544,342,765 bbl.
Same period last year (crude plus cond.)				*616,720,998 bbl.

*Includes 10,784,950 bbl. condensate. †Week ended previous Monday. ‡South Dakota.

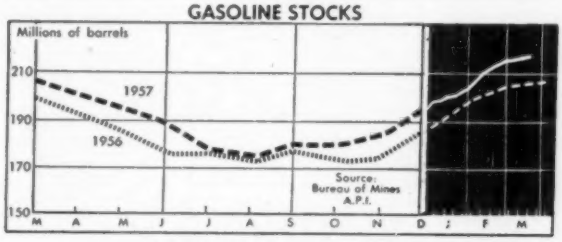
CRUDE-OIL STOCKS



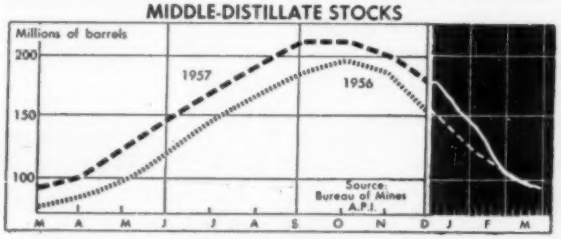
REFINERY RUNS



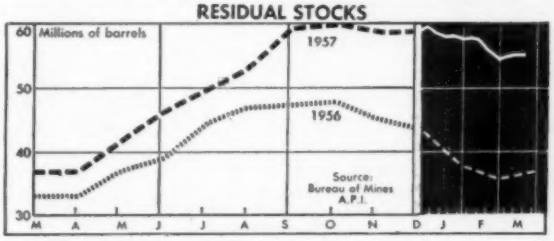
GASOLINE STOCKS



MIDDLE-DISTILLATE STOCKS



RESIDUAL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	3-15-58	3-8-58	3-16-57
Pennsylvania Grade	2,899	2,910	2,502
Other Appalachian	1,556	1,512	2,078
Illinois, Indiana, and Michigan	10,426	10,879	9,479
Nebraska and North Dakota	2,446	2,365	1,951
Kansas	9,462	9,216	8,904
Oklahoma	18,391	‡18,244	21,485
Arkansas	2,846	2,875	2,424
Louisiana	19,551	20,097	18,310
North	3,287	3,480	2,902
South	16,264	16,617	15,408
Mississippi, Alabama, and Florida	2,387	2,423	2,140
New Mexico	8,189	8,343	7,362
Texas	127,321	128,347	113,556
East Texas	8,555	9,127	10,565
West Texas	56,166	55,682	52,932
Texas Gulf	27,666	27,810	21,520
Other Texas	34,934	35,728	28,539
Wyoming	15,702	15,266	16,994
Other Rocky Mountain	7,085	7,062	6,753
California	38,703	39,274	26,543
Foreign	†16,882	17,003	11,440
Total	283,864	‡285,816	251,921

*Bureau of Mines. †Includes 4,702,000 bbl. in California. ‡Revised.

API REFINERY REPORT—MARCH 21, 1958

(Thousands of barrels)

District—	Daily avg. runs	Daily average production: Gaso.*	Kero.	Dist.	Resid.	Stocks‡: Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1957: Daily avg. runs	Daily average production: Gaso.*	Kero.	Dist.	Resid.
East Coast	1,102	465.0	36.0	284.6	207.4	45,218	7,531	25,109	10,795	1,229	504.4	44.7	323.2	219.3
Appalachian:														
District 1	93	40.3	5.4	22.4	7.7	5,135	501	1,628	581	104	40.1	4.6	24.6	9.6
District 2	111	49.3	6.9	19.6	11.6	2,910	277	727	478	109	54.2	7.6	19.0	14.6
Ind., Ill., Ky.	1,338	691.3	81.7	282.7	164.9	41,044	3,279	10,587	3,941	1,400	684.8	71.6	283.2	184.8
Minn., Wis., Dak.	117	49.3	2.7	34.4	24.4	7,077	499	3,515	572	103	48.6	6.5	24.7	7.9
Okla., Kans., Mo.	595	326.7	16.4	154.8	24.3	20,927	737	6,520	962	683	368.7	16.3	156.1	35.2
Inland Texas	257	178.0	12.7	39.3	24.3	9,067	334	1,300	2,063	270	207.0	8.8	53.7	21.6
Texas Gulf Coast	1,678	809.1	101.4	441.3	170.8	30,290	1,630	7,463	4,152	1,953	861.7	106.4	532.2	237.7
La. Gulf Coast	609	343.6	55.3	146.9	39.3	12,554	1,318	4,536	1,188	666	301.8	51.1	183.2	48.5
N. La. and Ark.	98	34.3	12.6	23.4	13.9	5,304	488	1,611	141	93	35.0	6.3	23.1	6.7
Rocky Mountain:						399	17	102	88	26	14.0	0.5	4.8	3.3
New Mexico	26	12.4	1.0	5.6	3.1	8,192	230	2,599	866	267	126.6	2.4	68.6	33.2
Other Rocky Mt.	234	116.4	1.2	54.4	36.1	28,790	337	12,752	29,186	1,144	496.2	5.7	164.2	382.5
West Coast	1,058	455.3	2.4	145.9	300.3									
Mar. 21, 1958	7,316	3,571.0	336.0	1,655.3	1,028.1	216,907	17,178	78,449	55,013	8,047	3,743.1	332.5	1,860.6	1,204.9
Mar. 14, 1958	7,479	3,663.9	384.7	1,698.7	1,023.0	216,525	17,459	81,853	55,061	.....	.....	.....	.....	.....
Mar. 22, 1957	7,976	3,580.0	323.6	1,836.4	1,197.9	205,521	19,978	77,603	36,886	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):

Regular (89 octane)	11.00-11.50
Premium (98 octane)	13.75-14.25

Gulf Coast (cargoes for coastwise or export movements):

Regular (90 octane)	9.75-10.25
Regular (92 octane)	10.00-10.50
Premium (97 octane)	11.50-12.00
Premium (98 octane)	11.75-12.50

California (rack) (Los Angeles):

Regular (88 octane)	12.0
Premium (96 octane)	14.5
Premium (98 octane)	15.0

Caribbean area (cargoes):

Regular (87 octane)	9.625-9.875
Premium (93 octane)	10.50-10.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:

Grade 26-70	4.5

Breckenridge:

Grade 26-70	4.0

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):

Kerosine 42-44	9.25-9.50
Diesel oil (58 d.i. and above)	8.875-9.125
Distillate No. 1	8.875-9.125
Distillate No. 2	8.25-8.50

Gulf Coast (cargoes):

Kerosine 41-43	8.625-8.75
Distillate No. 2	8.125-8.375

New York Harbor (barges):

Kerosine 41-43	9.65
Distillate No. 2	9.15
Diesel fuel, 48-52 d.i.	9.75

Caribbean area (cargoes):

Distillate No. 2	8.125

WAX (LB.)

Oklahoma (Group 3):

132-135 A.m.p. (semi-refined) in tank cars	6.50

New York (export):

126-130 A.m.p. crude-scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
★ Residual fuel (max. 1% S)	$1.25-1.30
Gulf Coast (cargoes):	
Bunker C fuel	$2.25-2.40
New York Harbor (barges):	
Bunker C fuel	$2.65
Caribbean (cargoes):	
Bunker C	$2.25
California (rack):	
Bunker C fuel, Los Angeles	$2.65-2.80

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	23.0
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	20.5
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	26
200 vis. neutral (180° at 100°), 25 p.t.	24

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour) (§)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.81
16-16.9	2.74	....	....	....	1.86
17-17.9	2.78	....	....	....	1.91
18-18.9	2.82	....	....	....	1.96
19-19.9	2.85	....	....	....	2.01
20-20.9	2.89	$2.75	....	$2.62	2.06
21-21.9	2.93	2.77	....	2.64	2.11
22-22.9	2.97	2.79	....	2.66	2.16
23-23.9	3.01	2.81	$3.44	2.68	2.21
24-24.9	3.05	2.83	3.46	2.70	2.26
25-25.9	3.09	2.85	3.48	2.72	2.31
26-26.9	3.13	2.87	3.50	2.74	2.36
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low cold test Gulf Coast. ‡Sour. §Some heavy Wyoming sour posted at 8 cents less.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, Feb. 3, 1958.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.40
Middle District	4.22
Southwest Pennsylvania	3.93
West Virginia	3.75
Buckeye Grade	3.75
Illinois Basin	3.00
Canada:	
Leduc-Woodbend	2.74
Redwater (Alta.)	2.63
Smiley (Sask.)	2.40
Pembina	2.61

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 41°-41.9°, Puerto La Cruz	3.34
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
★ Quiriquire, 16.0-16.4, Caripito	2.30
★ Lagunillas heavy, flat, Amuay or Las Piedras*	2.25
★ Bachaquero, flat, 15°-16°, Las Piedras*	2.05

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$2.12
Iranian, 34.0°-34.9°, Bandar Masur	2.04
Iranian, 34.0°-34.9°, Abadan	1.99
Iraq, 35.0°-35.9°, Fao	1.98
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.85
Qatar, 41.0°-41.9, Umm Said	2.23
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.49
Iraq, 36.0°-36.9°, Tripoli, Banias	2.49
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

Gulf-U.S.N.H., clean (USMC—30%)	$2.00
★ Carib.-U.S.N.H., clean (USMC—35%)	1.76
★ Gulf-U.K., clean (USMC—30%)	5.36
★ P.G.-U.K., dirty (USMC—62.5%)	4.09

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1 GMC PERFORATING TRUCK, complete with Gamma Ray logging equipment. 20,000' line capacity. Perfect condition. Will sell with or without logging equipment and line. Box K-487, The Oil and Gas Journal, Tulsa, Oklahoma.

BETHLEHEM TRIPLEX Plunger Pump, Model TP-3, excellent condition. Suitable for salt water disposal. Can handle 1000 barrels per day at 1000#. Dorset Company, 610 National Bank of Tulsa Building, Tulsa, LU 4-7769.

IMMEDIATE DELIVERY Indiana, Pa., 1775'—5½" Drill Pipe, 21.90#, Grade D, Range 2, Internal Upset Reed Super Shrink Joints, drilled 1200'. Simpson Drilling Co., P. O. Box 372, Indiana, Pa., Phone: 5-5575.

FOR SALE in Kansas and Oklahoma, 15—10' x 40' horizontal steel gasolene storage tanks riveted and welded type. Complete data upon request. Cities Service Oil Company—Patridge—Bartlesville, Oklahoma.

2—USED 36-L Bucyrus-Erie Spudders. One equipped with Gas-Gasoline Engine, one with Diesel. Also two used 145 GK Waukesha Engines. The Buckeye Supply Company, P. O. Box 1231, Zanesville, Ohio.

LEE C. MOORE 97' telescoping mast, 201,000 hook load; 5,400' 4½" racking capacity. Will design and build trailer and substructure to meet customers machinery and drilling requirements. May be purchased direct or through supply store. Also reconditioned Lee C. Moore 9' x 40' substructure for 126' mast $5,000.00. Branham Oilfield Specialties Company, Inc. P. O. Box 14497, Houston 21, Texas. REpublic 3-4391.

COMPLETE ROTARY RIGS

two to ten thousand feet. Terms available. Will lease with option to purchase. For price and location contact

Cardwell Investment Company, Inc.
G. D. DRYDEN—AM 5-2611
604 Petroleum Building
Wichita, Kansas

FOR SALE EQUIPMENT

WELL SERVICING Equipment—Wichtex C-60 and C-65 heavy duty double drum units mounted on tandem trucks, three Ford pickup trucks plus complete tools, lines and equipment. Priced to sell. Located Abilene, Texas. Phone OR 2-5734, Abilene, or ED 6-3788, Fort Worth.

MOTORS AND GENERATORS

1500 HP D.C. MOTORS

1500 HP—525 volts D.C.—600 R.P.M.—NEW—2-bearing continuous duty motors—manufactured by Westinghouse. In original crates. From Navy Destroyer Escort. SPECIFICATIONS: 2-bearing 1500 HP—525 volts DC—2270 amps—600 RPM—ambient temperature 40° C—class B insulation—2-bearing pedestal sleeve type—shunt wound—efficiency 94.23%. ONLY 6 AVAILABLE—BUY NOW AND SAVE. Suitable for steel mill drive—offshore oil rigs—rolling mill drive—dredge pump applications.

1200 KW GENERATORS

(2) Equal to new—manufactured by Allis-Chalmers. 1200 KW—525 volts D.C.—2290 amps—750 RPM—cooling self-ventilated—totally enclosed—separate excitation—continuous duty—class B insulation—Mfg. type M.H.C.—frog leg armature.

The Boston Metals Co.

313 E. Baltimore St. ELGIN 7-5050 — Baltimore 2, Md. LEXINGTON 9-1900

"We Own The Equipment We Advertise"

TANKS & TOWERS

14' x 21' x 1" Shell, Steel
12' x 43' x ⅜" Shell, Steel
8½' x 19' x ¼" Shell, T-316SS
14" x 40' Tower, 160#
18" x 23' Tower, 160#
24" x 28' Tower, 550#

8' x 75', 20 Tray, 25#
5' x 98', 40 Tray, 135#
24" x 45', 24 Tray
18" x 32', 15 Tray, 160#
12" x 27', 20 Tray, 450#
24" x 42', 22 Tray, 230# T-304SS
18" x 23', 11 Tray, 200# T-316SS
30" x 20', 8 Tray 50# T-304SS

Valves: Steel & SS ½" through 6"
Furnaces: Petro-Chem, ½, ¾ mil. BTU-HR.

HEAT EXCHANGERS

Steel Tube: 1000, 900, 650, 500, 300, 200 sq. ft.
Adm. Tube: 2250, 2200, 1300, 900, 740, 625, 300 sq. ft.
S.S. Tube: 1228, 947, 570, 536, 380, 315, 250, 157 sq. ft.
4-6% Chr. Tube: 1000, 500 sq. ft.
Fin Tube: 73, 21, 11 sq. ft.

PUMPS

Hot-Oil: 324 gpm @ 4600'; 735 gpm @ 3100'; 400 gpm @ 2000'; 1270 gpm @ 406'.
Water: 10,500 gpm @ 135'

COMPRESSORS

Worth.: LTC-6, Gas Engine, 800 hp.
Penna.: 100 CFM @ 500#; 385 CFM @ 150#

PARTIAL LIST ONLY—FOR DETAILED CIRCULAR

WIRE! PHONE! WRITE!

BRILL EQUIPMENT COMPANY

4101 San Jacinto St., Houston 4, Texas, JA 6-1351
2401 Third Ave., New York 51, N. Y., CYpress 2-5703

FOR SALE EQUIPMENT

36-L BUCYRUS SPUDDER on skids or trailer mounted. Near Chicago. Excellent condition. Butane and gas. Phone 498-J, J. M. Berry, Skiatook, Oklahoma.

2 WALKER-NEER SPUDDERS—Models C-34 & S-33. Complete drilling and completion tools—Robert Boyle, Okla. City, Okla.

136' A.P.I. LEE C. MOORE Type "K" 800,000# Galv. Derrick complete with 9'6" x 30' steel sub struct. & 9'2" x 8' x 22' engine base on 1'8" sub base. New condition. Box 1586, Okla. City. ME 4-3354.

FOR SALE EQUIPMENT

WELL DRILLS - CORE DRILLS. Everything for well and core drilling in both new and used equipment, at money saving prices. Fishing tools rented. Send for bulletins. Pressey & Son, Pueblo, Colo.

FAILING—Rotary Rig—Capacity 2500 Ft. 2900 Ft. 2⅞ in. x 30 ft. drill pipe, top grade, with new tool joints. Gardner-Denver Pump 5 x 10 skid-mounted, 3—30 ft. drill collars. Hughes core barrel. This rig too large for our needs. Price $20,000. Would consider top grade 1500 ft. at actual value—balance—cash. Hobert Betz—Lane, Kansas—Phone 39.

FOR SALE EQUIPMENT

SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment; from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply Co., Tulsa.

1 36L BUCYRUS Spudder complete with 5 and 7 inch tailing in tools. Dog house, butane tank, junk rack and light plant. Rod and tubing tools and hand tools. Phone Office 144, Res. 614, Cleveland, Oklahoma.

CLOSE OUT SALE 60L Bucyrus 282 Star, all tools. 1500 Failing, complete, like new. Casing and Line pipe. Box 1215 Tulsa. Phone DI 3-9563.

THOUSAND POUND working pressure, low temperature Natural Gasoline Extraction plant. New 1950, built by Black, Sivalls & Bryson, capacity 10 MMCF. Will sell whole or in part. Contact Drew Cornell, Inc., P. O. Box 1267, Oil Center Station, Lafayette, Louisiana.

WANT EQUIPMENT: Did you find the equipment you wish to purchase in this column? If not, use an "Equipment Wanted" classified advertisement to find it. It is available somewhere and Journal classified advertisements will find it. See box heading for classified rates or write The Oil Journal.

FOR SALE

3—265 KW 50 CYCLE A.C. GENERATORS
1—292 KW 50 CYCLE A.C. GENERATOR

all manufactured by Electric Machinery Manufacturing Company. We acquired these generators while trading on various lots of equipment. The generators have been used for about two years and are in excellent condition. Engines are not included.

WRITE OR CALL C. L. KLEPPER

EL PASO NATURAL GAS COMPANY,

P. O. BOX 1492 EL PASO, TEXAS KEystone 2-2911

NOW DISMANTLING HOUDRIFLOW CAT CRACKING UNIT
TIDEWATER OIL CO.—DRUMRIGHT, OKLA.—NEW 1950

2 PETRO-CHEM Iso-Flow Furnaces. 19 & 25 Million BTU/hr.

FINES SEPARATORS, Centrifix 16" type RVD
FRESH CATALYST ELEVATOR, 72' cc, 8" x 5" Buckets.
BAROMETRIC CONDENSER, Elliott #06HB, 8500# Steam/hr.

BINS & HOPPERS

Fines Storage, 6'0" ID x 10'6".
Catalyst Lift Disengaging, 12' & 5'6" ID x 51' OA—5% Chrome.
Catalyst Hopper 6'0" ID x 4'0".
Catalyst Storage & Shutdown Hopper 12'6" ID x 160'11" OA.
Fresh Catalyst Hopper 3'0" OD x 6'0".
Drums & Receivers: 8'0" x 28'9"; 6'0" x 14'0"; 5'0" x 14'0"; (3) 4'6" x 16'0"; (2) 4'0" 12'0".

PEABODY Direct Fired Air Heater, 10,000 SCFM.

TOWERS

8'0" x 75'0"	25 PSI	4 Baffle & 22 Bubble Cap Trays
6'0" x 30'0"	50 PSI	9 Trays
5'0" x 56'0"	50 PSI	26 Trays
3'0" x 45'0"	260 PSI	Packed
3'0" x 32'0"	40 PSI	8 Bubble Cap St Steel Trays
3'0" x 23'6"	600 PSI	Packed
2'6" x 77'6"	275 PSI	32 Bubble Cap St Steel Trays
2'6" x 43'6"	180 PSI	24 Bubble Cap Trays
2'6" x 30'0"	270 PSI	Packed

REGENERATION AIR BLOWER, 11,000 CFM, 11 PSIG, Turbine Driven.

REBOILERS

All Steel U-Tube Bundles, Sq. Ft. Area: 947; 705; 220; 165.

POMONA PUMPS

GPM	PRESSURE	DRIVE
2600	75 PSI	200 HP Motor
2600	75 PSI	160 HP Turbine
1550	75 PSI	125 HP Motor (2)
680	65 PSI	40 HP Motor

COOLING TOWER FLUOR INDUCED DRAFT, 6750 GPM, Three Cell Unit.

HEAT EXCHANGERS - CONDENSERS

Steel Tube (8) 170, 705, 880, 1060, 1500 Sq. Ft.
Adm. Tube (18) 331, 540, 705, 948, 1060, 1750 Sq. Ft.
CUPRO-NICKEL Monel Clad Shell 1495 Sq. Ft. (6)
BROWN FINTUBE, Steel Shells & Tubes 600 PSI 600° F. 68 from 92 to 158 Sq. Ft.

BLOW DOWN DRUM & STACK, 8'0" ID x 17'0", STACK 18" Dia. x 110" High.

KILN 18'-6¼" ID x 55'8" OA

BYRON JACKSON CENTRIFUGAL PUMPS

1 Motor & 1 Turbine Driven

(4) 1½" x 2" Two Stage (8) 2" x 3" (4) 3" x 4" (4) 1½" x 2½" Two Stage (2) 4" x 6"

REACTOR, Stainless Steel Lined, 14'0" ID x 44'2" OA

DUPLEX & SIMPLEX STEAM PUMPS

12 x 5 x 12 (2)
8 x 4½ x 12 (2)
8 x 4 x 6 (5)
7½ x 4 x 10 (2)
6 x 4 x 6 (5)
4½ x 4 x 6 (1)
Hot Oil 6 x 4 x 6 (3)

INSTRUMENTS, complete instrumentation for control of all steps in process—Write for complete list.

PASSENGER ELEVATOR—Otis Electric 6' x 6', Travel 182'6" 10 Opening stops same side. Rate of Travel 300 FPM, Capacity 2500 lbs.

OTHER MODERN EQUIPMENT OFFERED AT TREMENDOUS SAVINGS,

PROPANE GAS DEHYDRATOR, 20,000 gals./day, Type EXHC SX Anders Fully Automatic dual tower.

AGITATOR TANK, 50,000 gal. capacity.

ETHYL BLENDING PLANT, 8,500 gallon—60 Ton Howe Weight-O-Graph.
HARDINGE CLASSIFIER.

FURNACE TUBES—4" x ⅝" x 24'8"—Croloy 5, NEW; 4½" x ⅞" x 29'6"—Croloy 5, USED; 5" x ¾" x 19'6"—Croloy 5, USED.

750 Ton Good Used Steel Pipe, 2" to 18".

200 Ton Flanges, Fittings, Valves, Steel & Cast Iron, Used.

1000 Ton Tank Plate, ¼" to ⅞", Used.

LARGE QUANTITY of Explosion Proof Motors, Electric Starters & Fittings.

AUTOMATIC TELEPHONE EQUIPMENT, Kellogg Cordless PBX—100 Circuit Switch Board, complete with 100 Telephones.

STORAGE & RUN DOWN TANKS

WELDED	RIVETED
80,000 bbl. Floating Roof	55,000 bbl. Cone (2)
80,000 bbl. Open	10,000 bbl. Cone (2)
10,000 bbl. Flat Roof	5,000 bbl. Cone (2)
5,000 bbl. Cone (3)	2,500 bbl. Cone
1,800 bbl. Cone (2)	1,800 bbl. Cone (12)
1,500 bbl. Cone (2)	1,500 bbl. Cone (2)
	1,000 bbl. Cone (6)

10,000 Bbl. Welded HORTON SPHEROID

HEAT & POWER CO., INC.

60 East 42nd St., New York 17, N. Y., MUrray Hill 7-5280
310 Thompson Bldg., Tulsa 3, Oklahoma. Diamond 3-4890
SITE OFFICE—Drumright, Okla., Phone 569

another ROSEN PUBLIC AUCTION

DRILLING RIGS—SERVICING UNITS

TO BE SOLD IN ENTIRETY, UNITS, OR PIECE-BY-PIECE IN

BANKRUPTCY SALE AT PUBLIC AUCTION

Pursuant to an order by Hon. Elmore Whitehurst, Referee in Bankruptcy, we will offer in Bankruptcy Sale at Public Auction these assets of . . .

Goggle Bros. Drilling Co. and Roy Oliver Palmer

Sale will be conducted on lot located approximately 200 feet south of intersection of

Sale will be held Rain or Shine!
In case of rain, sale will be held by catalog at Windsor Hotel in Abilene.

AMBLER AND TREADAWAY

ABILENE, TEXAS

TUESDAY

APRIL 15

1958

10 A. M.

INSPECTION

INSPECTION ANY TIME PRIOR TO SALE. Please inspect rigs at locations described above before coming to sale.

DRILLING RIGS:

WILSON MOGUL Jackknife Rotary Rig, located at Fletcher Drilling Co. yard 2½ miles east of courthouse on Hiway 180, Breckenridge, Texas. Wilson Mogul draw works, Twin GM diesel engines, 85' Jackknife derrick, 4½' sun structure, 12" Brewster rotary table, 50-t traveling block, etc. Full inventory sent on request to auctioneer.

1952 Model KL-210 CARDWELL drilling rig located 2½ miles NW of Ira, Texas, on Bob Robinson lease. All pin type substructure and derrick, double drum draw works, Waukesha Power unit, 97' Moore cantilever jackknife derrick, 7¼x12 slush pump, 3.500' 3½" drill pipe, 2,000' 2" line pipe, etc. Full inventory sent on request to auctioneer.

MISCELLANEOUS:

Truck mounted Lincoln welder, pole trailer, Hobbs floats, light plants, ass't. cable, plus many other items.

SERVICING UNITS:

WICH-TEX "65" double drum pulling unit mounted on '55 International tandem truck.
WILSON SUPER double drum pulling unit mounted on '55 GMC "500" tandem truck.
CARDWELL single drum well servicing unit mounted on '42 Mack truck.

AUTOMOTIVE:

'56 Plymouth Savoy, 2 way radio; '53 Chev. pickup; '50 International, '48 International, '45 International winch trucks; Nabors floats. '55 Buick Special.

VALUABLE OIL LEASES:

Assorted working interests in 6 valuable oil leases in Eastland, Knox and Taylor counties, Texas. Contact auctioneer for further information.

TERMS: Cash, certified or cashiers' checks; 25% deposit at time bid is struck down, balance at a time to be announced by the auctioneer. Sale subject to confirmation of Referee in Bankruptcy.

TRUSTEE: Henry Hart, 408 Petroleum Bldg., Abilene, Texas
FOR BROCHURE AND COMPLETE INFORMATION CONTACT AUCTIONEER

RALPH ROSEN ASSOCIATES
AUCTIONEERS - REAL ESTATE BROKERS - APPRAISERS
DAVIS BLDG.-1309 MAIN-DALLAS, TEX.
Phone Riverside 7-2148

HELP WANTED

SALESMAN to sell established line of Oil Field Specialties in North Texas area. Replies confidential. Box K-619, The Oil and Gas Journal, Tulsa, Oklahoma.

MANUFACTURERS Representative for proven line of engine protective equipment. Several territories open. Box K-573, The Oil and Gas Journal, Tulsa, Oklahoma.

ACCOUNTANT—Independent Oil Operator located in Illinois needs an accountant familiar with all aspects of an operating company. In reply give summary of education, experience, salary expected and date available. Write Athene Development Co., Inc., P. O. Box 54, Champaign, Illinois.

PETROLEUM CHEMIST — Mid-Continent area refinery has immediate opening for Petroleum Chemist with degree and experience in analysis of petroleum products. Send resume and salary requirements. Box K-603, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER desired by major oil company. 3 - 5 years general experience in drilling, well completions, oil and gas production, reserve calculations and water flooding. Work to cover operations in Southeast and Southwest Saskatchewan. Salary compensation to conform with ability and experience. Send resume of personal history, education, experience and salary requirements to Tidewater Oil Company, Royal Bank Building, Regina, Saskatchewan, Canada.

WANTED:

Experienced tube salesman to represent Midwest tubing manufacturer throughout the Southwest. Please send complete resume and salary expected.

Box K-627, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs, $5.00 cash. OIML Co., Box 2603, Tulsa, Okla.

WANTED: Assistant Sales Manager for progressive oil field tank manufacturer in Mid-Continent area. Applicant must be experienced in production equipment such as high pressure separators, oil treaters, etc. Many company benefits. Top salary offered to qualified man. State qualifications in letter to Box K-618, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER:

Company has opening for man experienced in Rock Bit design and use. Metallurgical experience desirable. Send information on age, education, experience and salary expected to:

GLOBE OIL TOOLS COMPANY
11630 Burke Street, Los Nietos, California

OIL-FINDER

Aggressive, established independent has opening for an oil-finder. He must be a geologist but also a creative thinker. He must be honest, sober and conservative.

If you're inclined to work and can locate the reserves, we'll locate the salary. This is an exceptional opportunity for the right man.

Box K-621,

The Oil and Gas Journal,

Tulsa, Oklahoma.

HELP WANTED

TRANSLATORS. Proven ability to translate technical material into fluent English essential. Attractive full time or free-lance arrangement. All languages of interest, particularly Russian. Send resumé to A.T.S., Inc., Drawer 271, East Orange, New Jersey.

THE POSITION YOU WANT: Oil Industry companies are looking for men to fill every conceivable kind of position. If you didn't find the position in this column that you are looking for, use a "Situation Wanted" classified advertisement to state your qualifications. Some company is probably looking for your ability. See box heading for classified rates or write The Oil and Gas Journal, Tulsa, Oklahoma.

SALES REPRESENTATION

Wanted: Nationally known Electric Welded Steel Tube Producer has opening for sales representative in Oklahoma and Texas area.

Box K-626, The Oil and Gas Journal, Tulsa, Oklahoma.

WANTED—ENGINEERS

We are interested in employing Mechanical or Petroleum Engineers, preferably with a practical oil field background, including rotary or workover rig experience. Men in their twenties preferred; should be under age of 35.

BAKER OIL TOOLS, INC.

P. O. Box 3048
HOUSTON 1, TEXAS

HELP WANTED

GEOPHYSICIST

CALTEX has immediate openings in the Eastern Hemisphere for a Gravity Magnetic Supervisor to supervise gravity and aeromagnetic surveys who meets the following requirements:

- B.S. degree in Geophysics.
- Experience in gravity magnetic interpretation and depth computations.
- Some seismic experience desirable.

Initial salary commensurate with qualifications.

Send detailed resume covering personal data, experience summary and salary requirements to:

California Texas Oil Co., Ltd.

380 Madison Avenue

New York 17, N. Y.

Attention: Employment Section

SITUATION WANTED

GEOLOGIST - STRATIGRAPHER, twenty years experience Oklahoma, Texas, San Juan Basin. Geological Administrative Experience. Box K-596, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER: 29, family, four years diversified experience oil and gas production, gas processing and transmission. Obtaining MBA degree in June, available late June. Desire Administrative position requiring Engineering knowledge with independent producer. Box K-589, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, 31, single, 5 years experience with a major oil company, desires position with an independent. Box K-617, The Oil and Gas Journal, Tulsa, Oklahoma.

FORMER MANAGER of independent with Large Gasoline Plant Production and Drilling Departments. Would like to work with Independent some capacity. Box K-612, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST—M.S., 32, Surface and subsurface experience. Presently in Development, Gulf Coast major; desire relocation U. S. or Europe. Box K-609, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE PETROLEUM ENGINEER with 15 years production—Secondary waterflooding experience desires position. Has installed and operated successful floods. Box K-614, The Oil and Gas Journal, Tulsa, Oklahoma.

ECONOMIC ANALYST—Twelve years experience refinery operations integrated major. Desires comptrollership or equivalent responsible position progressive company. Supervisory experience. Business Management and Engineering Degrees. Box K-601, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOPHYSICIST-GEOLOGIST. Six years seismic interpretation, geologic compositing, diversified review and oil field experience. References available. Desires position foreign or domestic. Single. Box K-629, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATION WANTED

SENIOR Geological Draftsman, supervisory capacity. 12 years experience principally geologic and cartography desires foreign employment. Also Stenographic experience. 2048 Rimrock Road, Billings, Montana.

MUD ENGINEER, married, 32, six years experience with top service organization. Thorough understanding of drilling problems and mud control. Some product development and evaluation. Will relocate. Box K-623, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM CHEMIST & PHYSICIST—Considerable experience in research—Refinery/Field—seeks employment, preferably in South. Write: Lowthorp, 340 N.E. 58th Ct., Fort Lauderdale, Florida.

OPERATIONS MANAGER: Aggressive Administrator with twenty years diversified oil refining experience in successful domestic and foreign organizing, planning, staffing and operations. Proven ability direct efforts others and control costs. Degree. Immediately available. Box K-625, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER with B.S. Chemical Engineering. Five years experience as technician and director of petroleum engineering laboratories. Cores, crude oils, waters, gases, limes, sands, condensates, bottom hole samples and refinery products. Refinery process, water flooding, dehydration and varied field experience. Desires supervision over refinery or petroleum engineering laboratory, however will consider anything. Willing to travel. Box K-622, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST

Young (37), aggressive, explorationist seeks more responsible position with large or small independent. Broad background in surface, subsurface and geophysical coordination. Experience in Texas, California, Wyoming, Kentucky, and Alaska. B.A., M.S. If your company needs someone to originate, direct, and/or pursue a sound program of oil exploration, I am your man.

Box K-534, The Oil and Gas Journal, Tulsa, Oklahoma.

ROYALTIES

OFFERING CHOICE ROYALTIES with large estimated reserves per dollar invested. A. S. Berry, 520 Wright Bldg., Tulsa, Okla.

WE WANT producing royalties, producing oil & gas properties, also farmouts gas acreage. Ben H. Williams — Clarendon, Texas.

LEASE AND DRILLING BLOCKS

NOTICE OF SALE BY TRUSTEE IN DISSOLUTION OF CORPORATION OF PRODUCING ROYALTY INTERESTS IN CADDO COUNTY, OKLAHOMA.

NOTICE IS HEREBY GIVEN that on the 4th day of April, 1958, at the hour of 2:00 o'clock P.M., in the foyer of the Court House in the City of Alva, Woods County, Oklahoma, the undersigned will sell to the highest and best bidder for cash, subject to confirmation of the District Court of Woods County, Oklahoma, all of the right, title and interest of the Enid Drilling Company, dissolved, in and to the following mineral interests under the real estate described, which are now producing oil:

1. An Undivided 4/40ths mineral interest in and under the Northwest Quarter (NW¼) of the Southwest Quarter (SW¼) of Section Four (4), Township Five (5) North, Range Nine (9), W.I.M., Caddo County, Oklahoma.
2. An undivided 4/100ths mineral interest in and under the west Half (W½) of the Southeast Quarter (SE¼), and the West Half (W½) of the Southeast Quarter (SE¼) of the Southeast Quarter (SE¼), of Section Four (4), Township Five (5) North, Range Nine (9), W.I.M., Caddo County, Oklahoma.

The foregoing interests were adjudicated as being owned by said corporation by judgment in the case of W. L. Thatcher vs. Matie B. Glasgow, et al., No. 16,839, District Court of Caddo County, Oklahoma, on March 12th, 1954, and sale of such mineral interests is being made by the undersigned Trustee pursuant to Order of the District Court of Woods County, Oklahoma, entered January 15th, 1958, in The Matter of the Dissolution of the Enid Drilling Company, a Corporation, No. 10,748.

DATED February 19th, 1958.

JOHN B. DOOLIN, TRUSTEE.

Office: Alva State Bank Building
Alva, Oklahoma.

LEASE AND DRILLING BLOCKS

WORKING INTEREST, price $400 per ⅛ to drill No. 1-A well on 160 acre lease with more locations staked by geophysical survey on extension of structure where well came in with 85 bbls., 38 gravity. Well logs and details. Write, L. Snavely, Geologist, Box 315, Coweta, Okla.

OFFERS WANTED—Oil and Gas Lease; Grand County, Utah—T. 21 S. Range 19 E. S. L. B. & M. Sec. 12: N½ NW¼—80 acres. Box 1116; McCamey, Texas.

VALUABLE OIL LEASE property adjoining waterflood project of Major Oil Company. Two producing wells. One complete drilling rig. Speed Star Model 72. Fully equipped. Owner has other interests in New York. Unlimited possibilities. Box 32—Pine Ridge, Kentucky.

OIL OPERATORS: No oil prorationing in this area. LAKE ERIE EXPLORATORY BLOCK, Ontario side, 130,000 acres. Economic area, good structural and stratigraphic possibilities. Drillable contract basis. Requires $110,000 property expenditure first year. Principals only. Box K-628, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL AND GAS LEASES FOR SALE
70,000 ACRES—ALASKA PENINSULA

Southwest of estimated billion barrel Richfield Swanson River field where $30,000,000.00 exploration and development under way. This acreage near Humble Bear Creek Prospect toward north end of Alaska Peninsula.

Box K-605, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE

Two (2) U. S. Government Oil and Gas Leases—Total 3,526 Acres—San Juan Basin, New Mexico.

Township 22N, Range 8W, New Mexico, Sec. 20; N½ and SW¼; Sec. 21, N½ and SE¼; Sec. 22, S½; Sec. 27, all; Sec. 34, all. Total 2,560 acres.

Township 21N, Range 8W, New Mexico, Sec. 3, N½; Sec. 4, all. Total 966 acres.

INFORMATION

Leases form a solid block; the acreage is not committed to any unit agreement; ⅛ U. S. Government override; 2% additional overriding royalty on the 966 acres; leases have approximately five (5) years to run; acreage is adjacent to South Chaco Unit; nearest production two (2) miles.

Price: One-Hundred dollars ($100.) per acre and five per cent (5%) override. Leases to be sold in their entirety.

This invitation to an offer is subject to cancellation and revocation without prior notice.

Contact

Hershel L. Copelan M. D.

3032 South La Brea
Los Angeles 16, Calif.
Telephone REpublic 3-9282

LEASE AND DRILLING BLOCKS

WILL CHECKERBOARD—Have 1000 acres in good producing territory Licking County, Ohio. Possibility of 3 pay zones to 3000 ft. including Clinton sand. No proration in Ohio. Box K-608, The Oil and Gas Journal, Tulsa, Oklahoma.

BREATHITT CO., KY.—100 Acres. Big Corniferous play. Depth 1700-1800 ft. No proration. ⅝ths with well drilled—$9,500.00. Add. Adver. 500 S. St. James, Evansville, Ind. Phone GR 7-0092.

HOLMES CO., OHIO—No proration. Gas 24c M. Comb. Oil & Gas Wells. Two offsets. 1000-acre block. Depth 3,300' Clinton Sand. ¾ Int. with well drilled—$12,500.00. Add. Adver. 500 S. St. James, Evansville, Ind. Phone GR 7-0092.

PIPELINE CONSTRUCTION

(Continued from page 109)

ranean port on the Libyan coast.

Status: Pipe has been ordered.

• **Creole Petroleum Corp.**

Project: 100 miles of 30-in. from Temblador field to Caripito in Venezuela.

Status: Under way.

Contractor: **Pipe Line Engineering Co. and Oklahoma Pipe Line Constructors,** R. J. O'Connell, supt., office at Maturin.

Completion: April 30, 1958.

• **Elburz Oil Corp.**

Project: 1,000 miles of 38-in. to move Qum crude to the Mediterranean.

Status: Planned.

• **Iranian Oil Participants, Ltd.**

Project: 30 miles of 20-in. and 22 miles of 16-in. looping of Agha Jari to Bandar Mashur line.

Status: Planned.

Project: 50 miles of 26, 28-in. from Gach Saran field to new terminal at Kharg Island in the Persian Gulf.

Status: Planned.

Contractor: A joint venture of **Raymond Concrete Pile Co.** and **Williams Brothers Co.** of Tulsa; **Richard Costain, Ltd.,** and **John Brown, Ltd.,** of Britain; **Werkspoor & Bredoro** of The Netherlands.

• **Iraq Petroleum Co.**

Project: About 600 miles of up to 40-in. from Kirkuk field through Iraq to Turkish port of Iskenderun on the Mediterranean.

Status: Proposed. Survey completed.

• **Israel Line**

Project: 90 miles of 16-in. running northward along the Mediterranean Coast from Asdod Yam.

Status: Planned.

Completion: Mid-1958.

• **Middle East Pipeline**

Project: 1,500 miles of 38 and 40-in. line from Persian Gulf to Mediterranean at Iskenderun, Turkey.

Status: Proposed.

• **North-West Oil Pipeline Co.** (newly formed by six West German refiners, headed by affiliates of Standard Oil Co. (N.J.), and British Petroleum Co., Ltd.)

Project: 230 miles of 28-in. from refining centers in the industrial Ruhr area of West Germany to Wilhelmshaven.

Status: Work to start early 1958.

Contractor: **W. M. Lyles** in joint venture with two German steel firms.

Completion: November 1958.

• **Royal Dutch-Shell**

Project: 700-mile line across Europe from the Mediterranean to the North Sea, running through Eastern France, Luxembourg, West Germany, Netherlands, and Belgium. Main trunk to be 30-in.

Status: Company is considering project together with several other companies.

• **SOPEG** (Cie. Francaise de Petrole (Algerie) and Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie)

Project: 300 miles of 24-in. from Hassi Messaoud field in the Algerian Desert to Bougie on the Mediterranean Coast.

Status: To start fall 1958.

Contractor: **Entrepose Co.** jointly with **Ste. Parisienne pour Industrie Electrique.**

Completion: 1959.

• **Yacimientos Petroliferos Fiscales** (Argentina)

Project: 932 miles of 12-in. from Campo Duran to San Lorenzo.

Status: Planned.

Contractor: **TIPSA** (Fish Engineering Corp., Fish Northwest Constructors, Inc., Clark Brothers, North American Utility, Construction International Co.)

Status: Under way.

Completion: Mid-1960.

Project: 390 miles of 14-in. from fields in Neuquen Province, Argentina, to Bahia Blanca on the coast.

Status: Bids requested.

Project: 625 miles of 12-in. from Mendoza to San Lorenzo.

• **Yacimientos Petroliferos Fiscales Bolivianos**

Project: 174 miles of 10-in. and 44 miles of 8-in. from Sicasica, Bolivia, to Arica, Chile.

Status: Planned.

Contractor: **Williams Brothers Co.** and **Telescopic Pipe Line.**

Completion: October 1958.

Foreign Products Pipelines

• **Empresa Nacional de Petroles** Government of Chile and Cia de Petroles de-Chile (Copec), et al.

Project: 75 miles of 10-in. from Chile's coastal refinery at Concon to Santiago.

Status: Under way.

Contractor: **Williams Brothers.**

Completion: 1958.

• **National Iranian Oil Co.**

Project: 90 miles of 12-in. from Abadan to Ahwaz, Iran.

Status: To start spring 1958.

Contractor: **Entrepose Co.,** Paris.

Completion: Summer 1958.

Foreign Natural-Gas Pipelines

• **Cuban Gas Transmission Co.**

Project: 650-mile pipeline from Campeche area of Mexico across Yucatan and on the ocean floor to Havana, Cuba; 150 miles would be submarine.

Status: Being studied by Ebasco Services.

• **Gaz de France**

Project: 550 miles of 16 to 24-in. from Lacq field, southwestern France, to Paris, plus a 10-in. terminal to Nantes and 12 to 16-in. laterals to Lyons, making a 1,000-mile system.

Status: Under way.

Contractor: French contractors.

Completion: First stage in 1958; complete system in 1960.

• **North Thames Gas Board**

Project: Will extend its Shellhaven-to-Romford line to Coryton then to Canvey Island.

Status: Planned.

Completion: Summer 1958.

• **Petroleos Mexicanos.**

Project: 130 miles of 22-in. to parallel a 14-in. line from Reynosa to Monterrey.

• **Sui Gas Transmission Co.**

Project: 310 miles of 16-in. from Sui gas field to Moultan, Pakistan.

Status: Under way; to be extended later to Lahore with branches at Kot Addu, Jhang, Magiana, and Montgomery.

Contractors: **Pakistan Constructors,** a joint company of **Morrison-Knudsen** of Boise, Idaho, and **William Press, Ltd.,** of London.

Project: 145-mile line from Sylhet to Dacca, East Pakistan.

Status: Under consideration. If approved construction could start December 1958.

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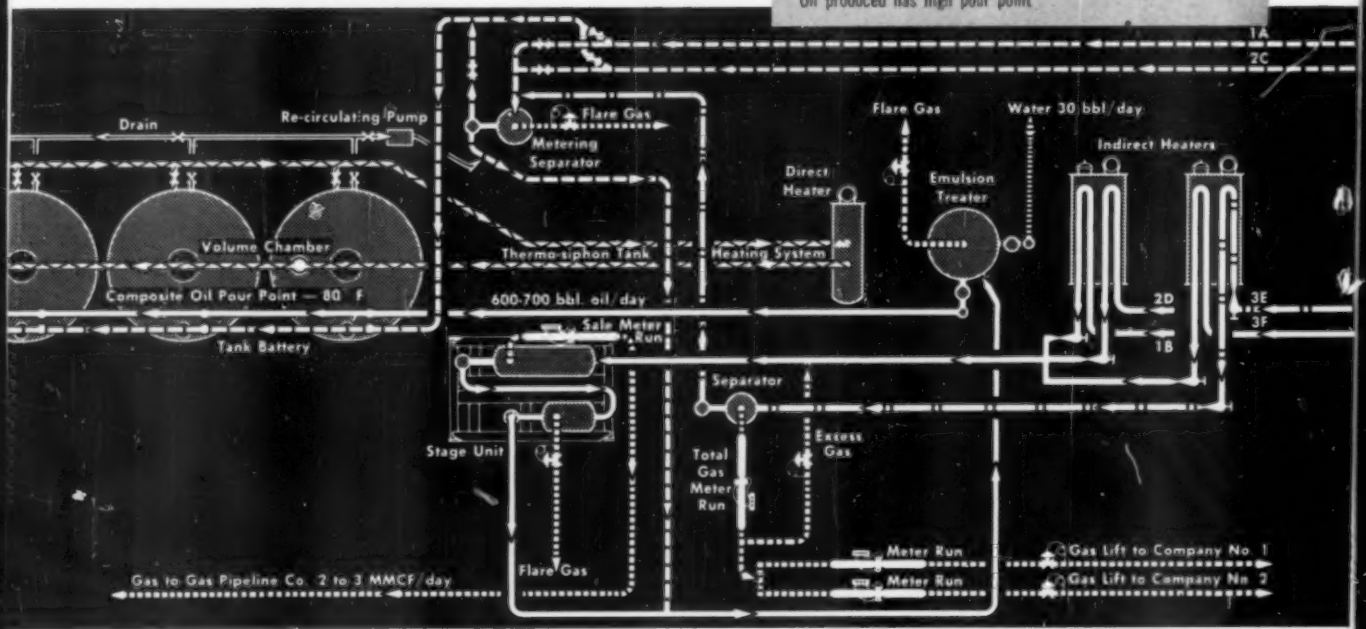
HOW TO PRODUCE 3-Dual Completed Wells

Problem: THREE DUAL COMPLETED WELLS

Well No. 1	Zone A—Gas Sand—8900' Zone—500 PSI Flowing Zone B—Foaming-Congealing Oil—11,500' Zone —3500 PSI Flowing
Well No. 2	Zone C—Gas Sand—8900' Zone—Gas Lift Zone D—Foaming-Congealing Oil—11,500' Zone —4000 PSI Flowing
Well No. 3	Zone E—Distillate—5500 PSI Flowing Zone F—Foaming-Congealing Oil—11,500' Zone —5000 PSI Flowing

Oil produced has high pour point



Solution:

Foaming-congealing oil from three zones is preheated in indirect heaters prior to separation in the special Monotube® stage separation unit. Separated dry gas is sold direct to pipeline.

Production from the two gas sands is separated in the metering separator, metered and commingled with oil production prior to treating in emulsion treater.

Each storage tank contains a set of vertical coils used as heat exchangers. Hot water is circulated thermosiphonically between water bath of direct fired heater and tank coils, to prevent high pour point oil from congealing. Gas from the distillate zone is used to gas-lift adjacent leases. The entire production arrangement is so complete and efficient, the pumper's time is held to a minimum.

Surface Equipment Includes:

- 5—Hi 500 Bbl. Bolted Galv. Cone Bottom Tanks w/Thermo-Siphon Vertical Heating Coils
- 2—4' x 10' 2xx4-14Y Indirect Heaters
- 1—6' XCP Emulsion Treater
- 1—2' x 10' Direct Fired Horizontal Heater
- 1—30" x 10' 3MDF-1030-15x Defoaming Stage Separation Skid Mounted Unit
- 1—2' x 6' 10N, 1000 PSI W. P. Separator
- 1—30" x 10' 125 PSI W. P. Metering Separator

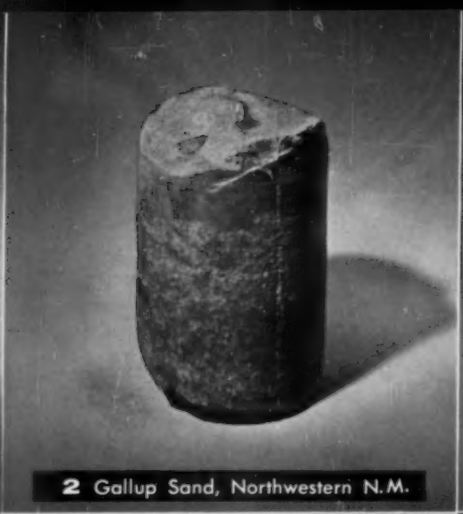
All equipment in this installation designed, manufactured, serviced and guaranteed by National.

It's a National®

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

1 Clear Fork Lime, West Texas

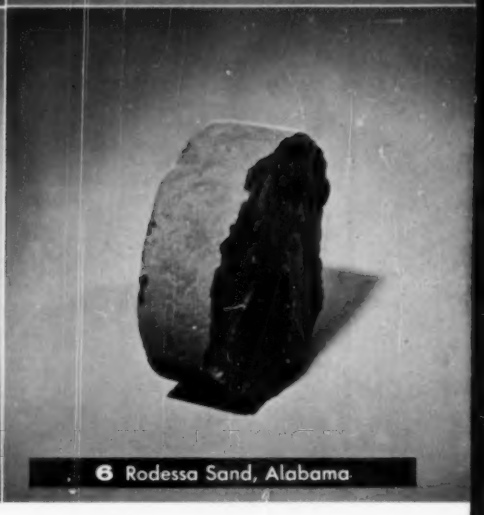


2 Gallup Sand, Northwestern N.M.

3 Triassic "D", British Columbia

4 Canyon Sand, North Texas

5 Wilcox Sand, South Texas



6 Rodessa Sand, Alabama

Dowell Guide To Fracturing

1 Clear Fork Lime, West Texas: This limestone contains varying amounts of dolomite and salt. Duofrac* has been quite successful — using large volumes of weak acid as a sand carrier. This fluid attacks both the formation and salt crystals. 50,000-gallon treatments, injection rates up to 50 bpm and ball sealers, are common. After treatment, some wells potential over 300 bopd.

2 Gallup Sand, Northwestern New Mexico: This core is from one of the better Bisti wells. Permeability is often less than one millidarcy and porosity ranges from zero to 12 per cent. Before treatment, wells often will not produce commercially. After a 500-gallon spearhead of Mud Acid, followed by Sandfrac* — using 50,000 gallons of lease crude and 50,000 pounds of sand at 30 to 40 bpm — many wells potential up to 600 bopd.

3 Triassic "D", British Columbia: This sandstone gas pay frequently produces commercially before fracturing. However, many operators have increased potentials by fracturing with Sandfrac*, using diesel oil with 100 pounds of FLA (Fluid Loss Agent) per 1,000 gallons. Treatments usually consist of 20,000 gallons fluid and 20,000 pounds sand down tubing at about 8 bpm. Results vary widely — with increases from two to 25 mmcfd being reported.

4 Canyon Sand, North Texas: Wells completed in this Pennsylvanian age formation often give high initial production (80 to 300 bopd). However, a steep decline curve to 8 or 10 bopd in six to nine months makes fracturing advisable. Usual treatment is a spearhead of 500 to 1,000 gallons of a special acid followed by Sandfrac* — using 10,000 to 20,000 gallons lease crude and 1½ pounds sand per gallon. FLA* (Fluid Loss Additive) is often used. Treatment generally increases production and reduces decline rate.

5 Wilcox Sand, South Texas: This shale-streaked sandstone is found from 8,000 to 11,000 feet. Bottom-hole temperature is high — from 225° to 300°F — and pay zones range from 15 to 200 feet in thickness. Stratafrac* is often used because it is designed to clean up fast and suspends sand well at high temperatures. Treatments range from 6,000 to 12,000 gallons injected at 3 to 5 bpm, with 1 pound of sand per gallon. Production frequently increases from less than 10 to 70 bopd through choke.

6 Rodessa Sand, Alabama: The Citronelle Field produces from two sections of dirty sand varying in depth from 10,400 to 11,600 feet. Super Mud Acid, with an added silicate control agent, is used to dissolve and shrink clays. Petrojel*, using 20,000 to 30,000 gallons jelled crude with 20,000 to 40,000 pounds sand is usually recommended. Ball sealers are frequently used to spread the effect of the treatment. Many wells then potential over 300 bopd.

With nine basic fracturing treatments and many variations of each, Dowell engineers can help you "tailor" treatments to the requirements of your job. Results have shown quick payouts, slow decline rates, few workovers, and excellent ultimate recoveries. Dowell Incorporated, Tulsa 1, Oklahoma.

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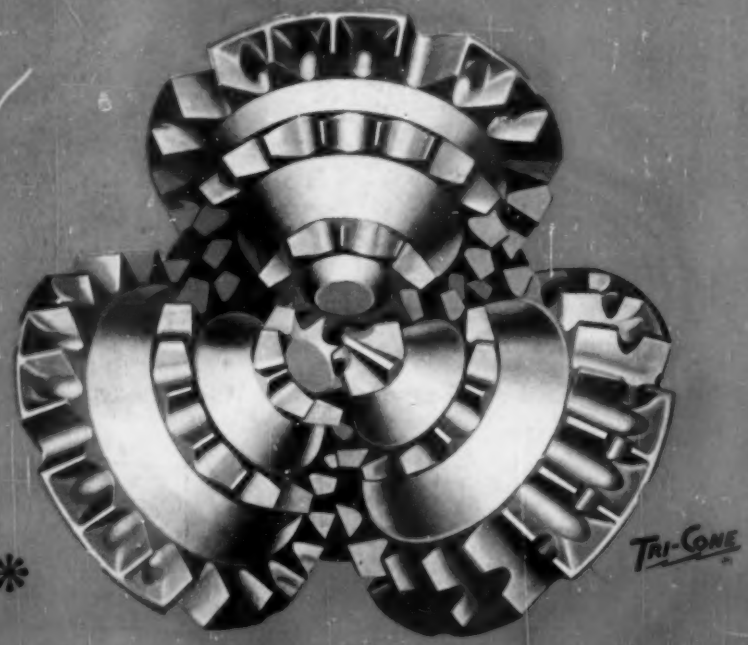

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Wherever you drill, Hughes bits — either regular or Jet — will be available in the sizes and types best suited to your particular drilling requirements. And of this you can be sure — the bits you get will incorporate the very latest in rock bit improvements!

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